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Astley Paston Cooper

(1768-1841)

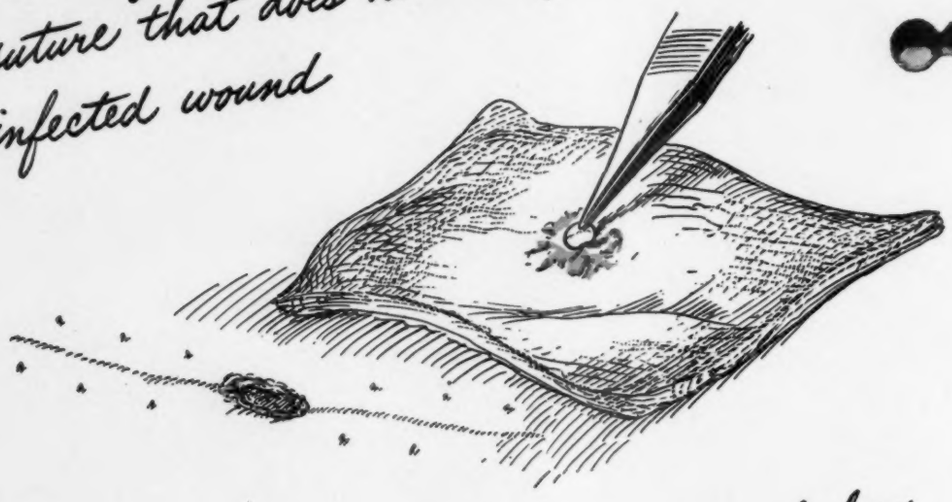
SUTUREGRAM

NUMBER ELEVEN IN A SERIES

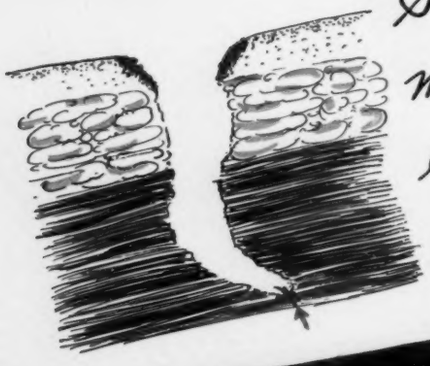
Complications of Suturing with Nonabsorbable Sutures

(a) Foreign Body Sinus

Sinus forms about the nonabsorbable suture that does not slough from the infected wound



✓ Sinus is cured by mechanical removal or eventual sloughing of suture



SUTUREGRAM

NUMBER ELEVEN (CONTINUED)

(b) Ulceration

Nonabsorbable sutures may penetrate mucosa of intestine or stomach. Ulceration occurs and suture sloughs. Ulceration persists if suture remains attached

✓ Prevention: Use catgut; small bite interrupted sutures

(c) Calculus

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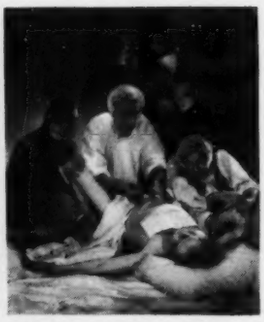

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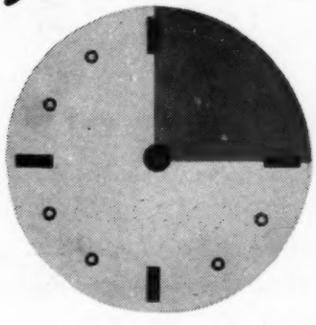

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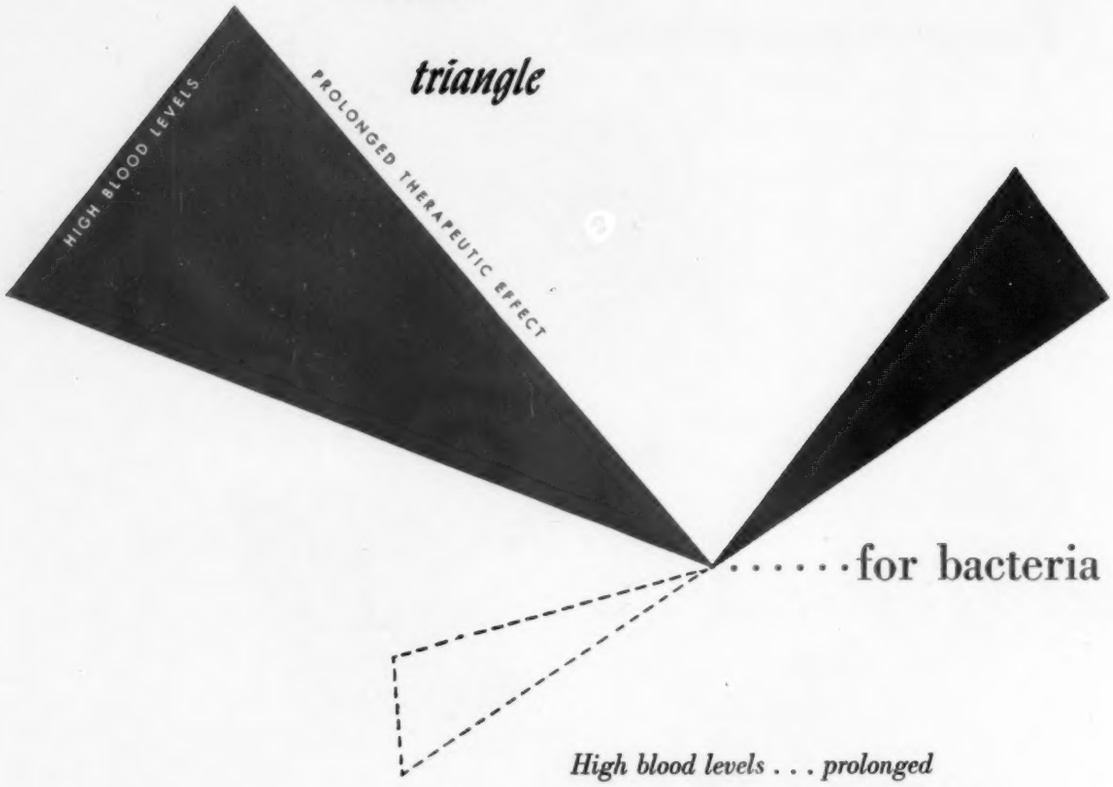

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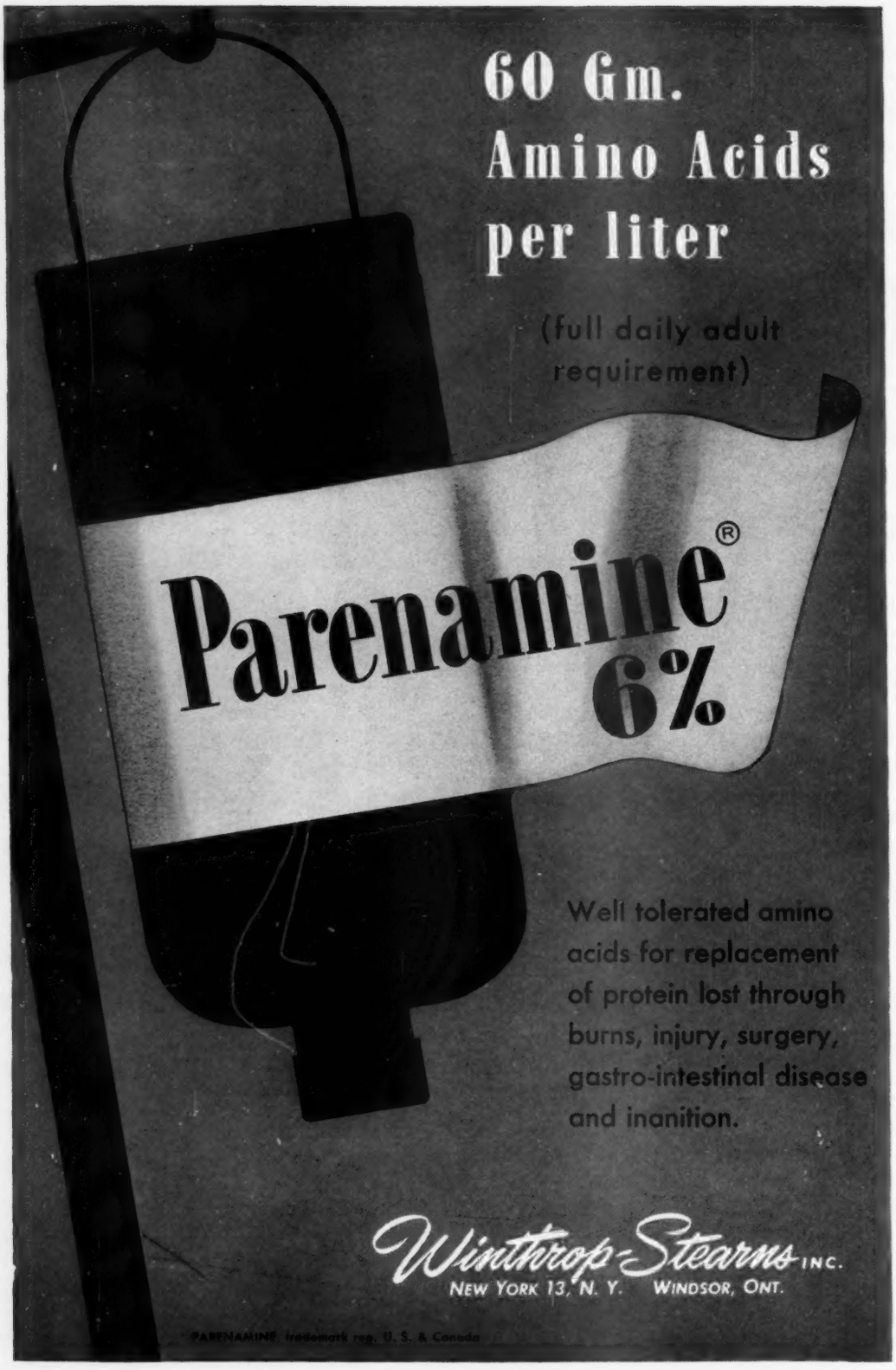
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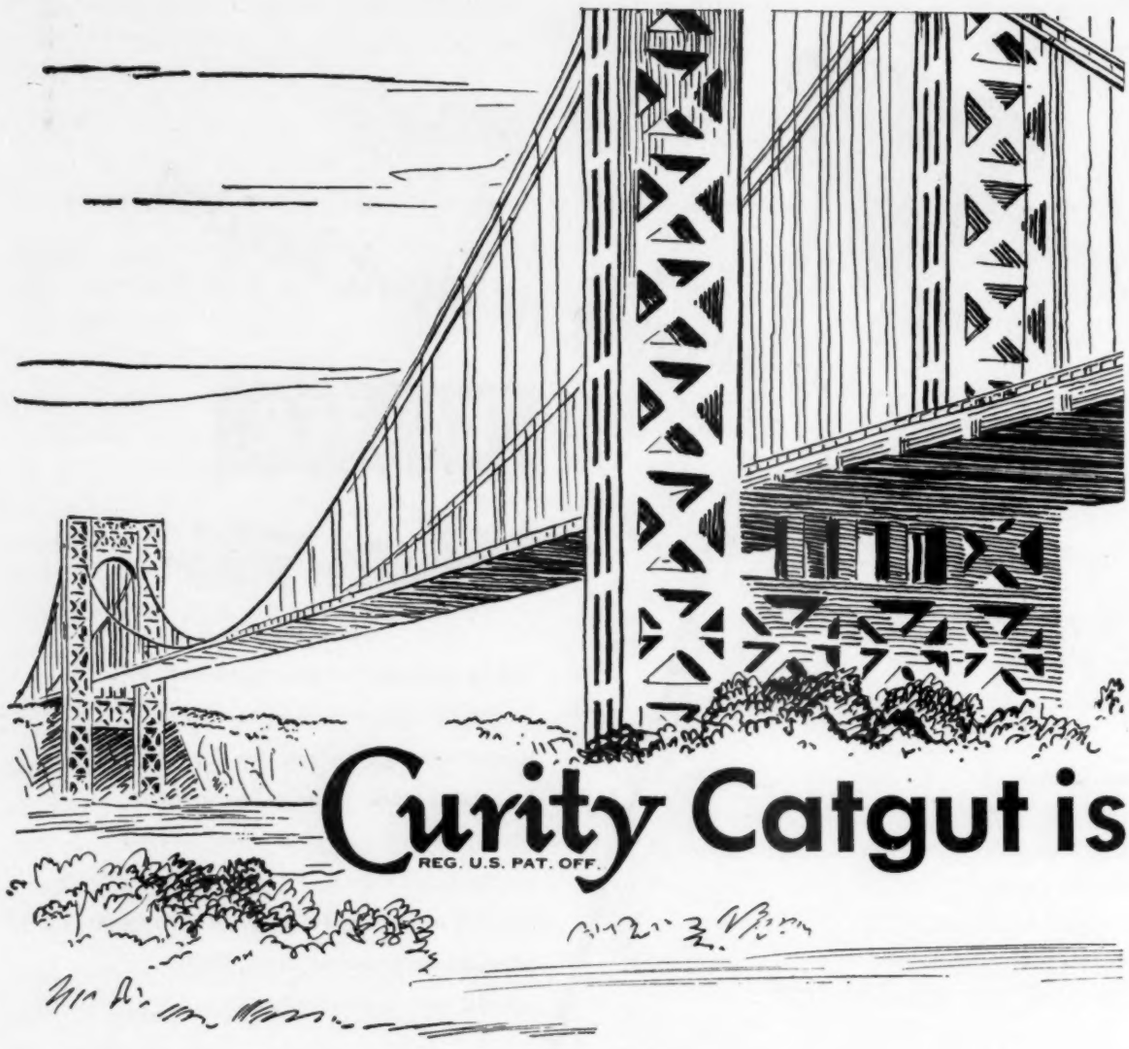

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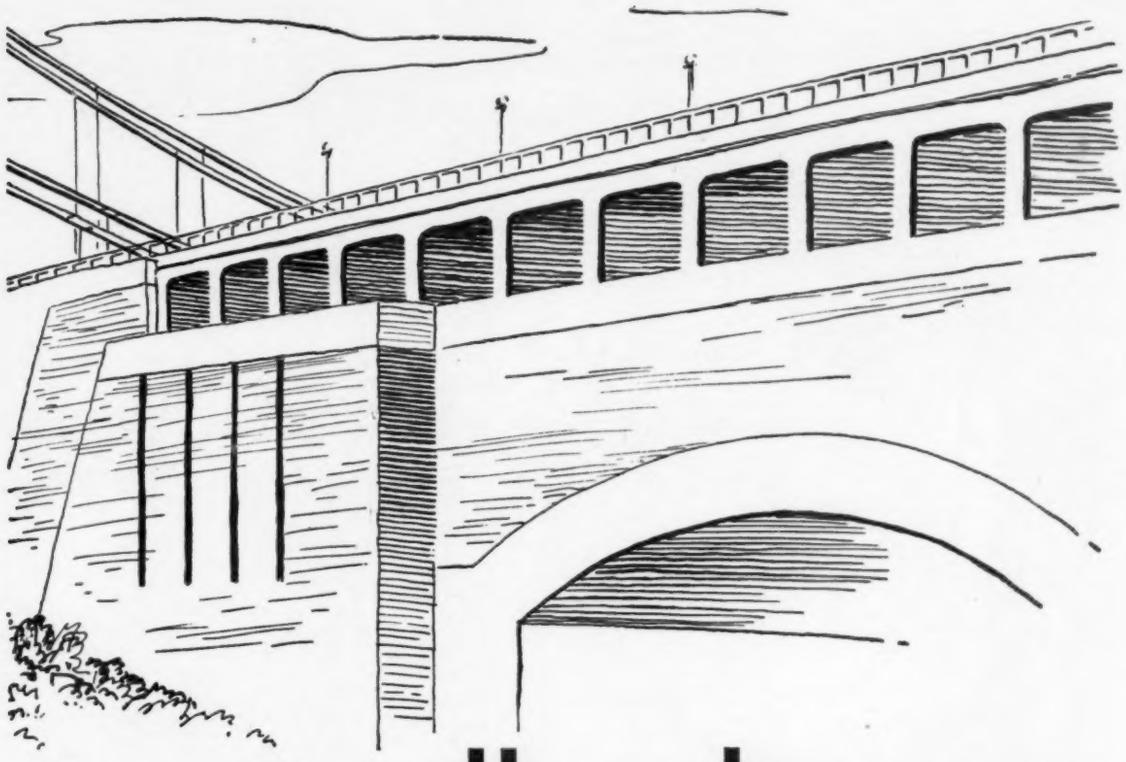

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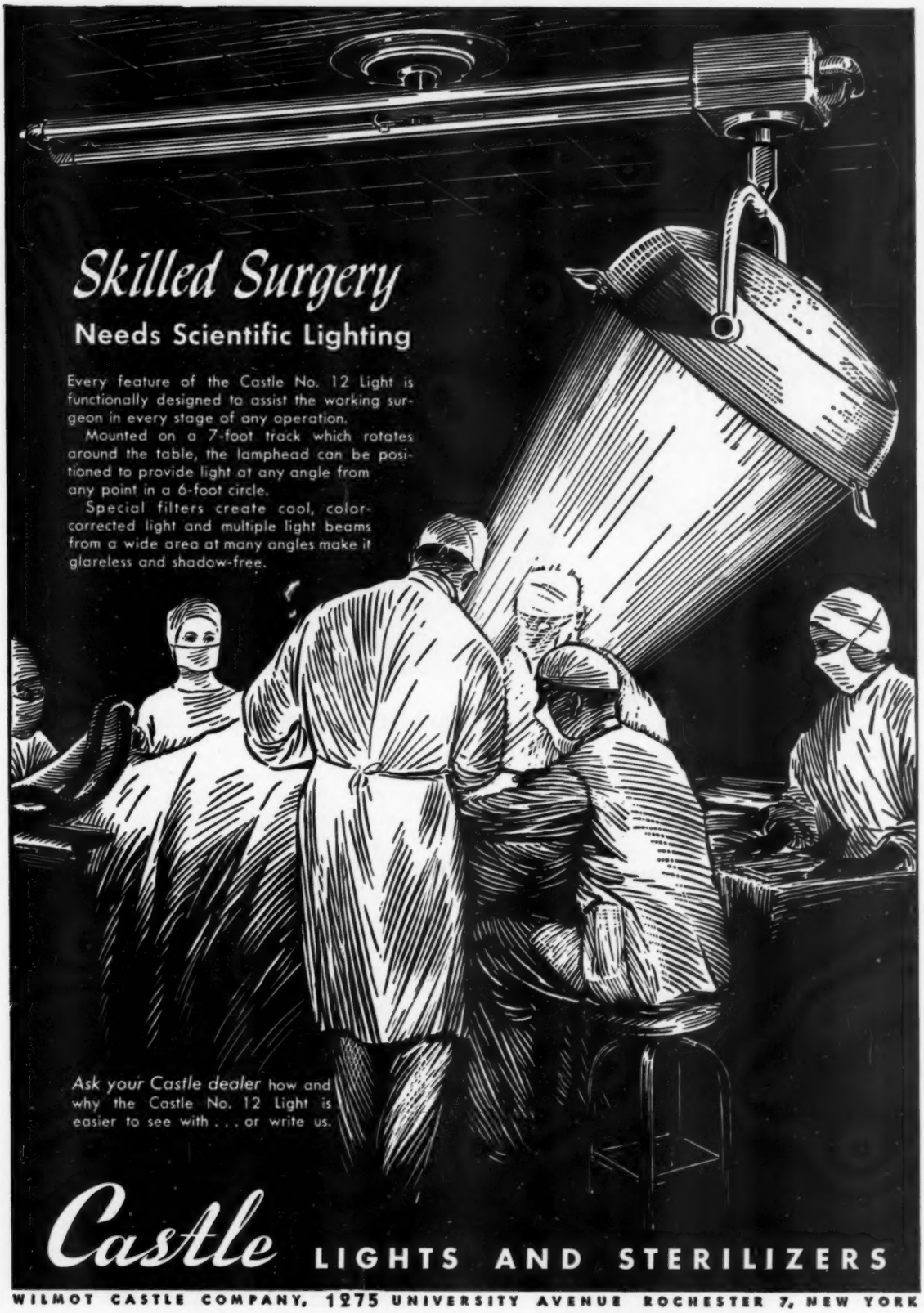
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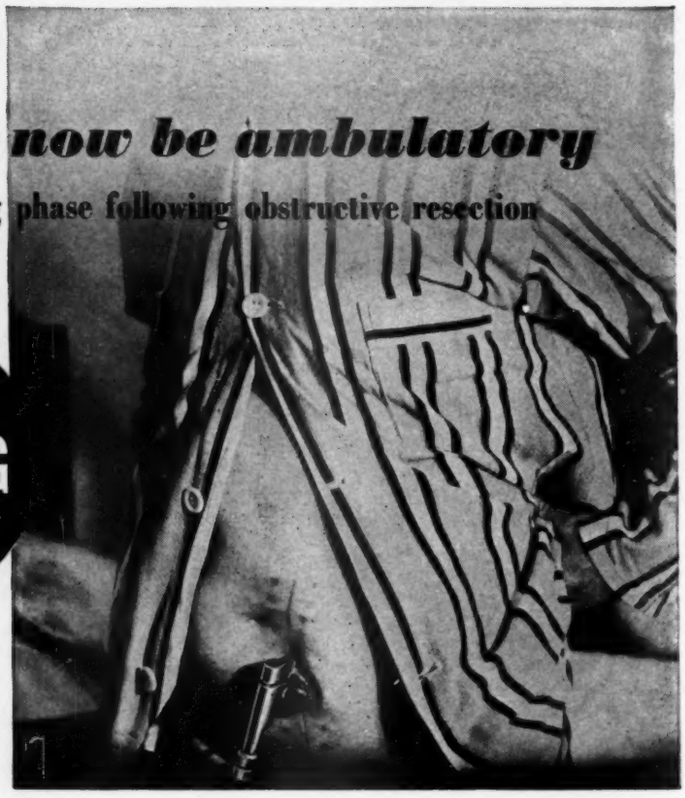

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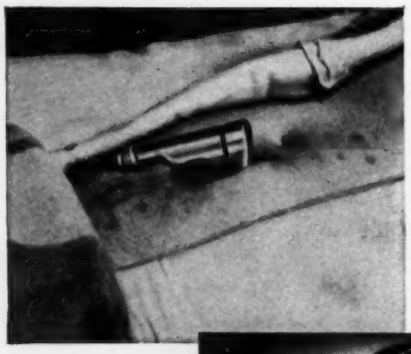

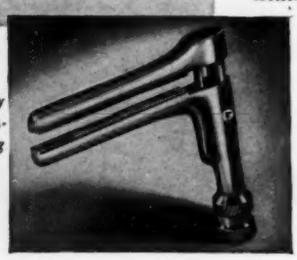

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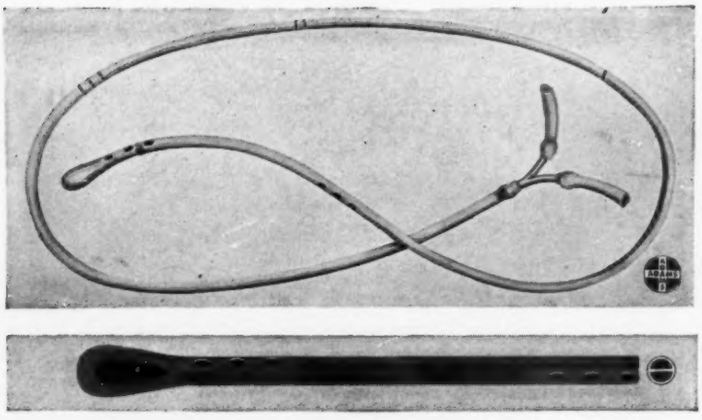

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(*continued on page 26*)

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*Boehme, E. J.	The Treatment of Chronic Leg Ulcers	The Lahey Clinic Bulletin, 4:242 (1946)
Bowers, Warner F.	Chlorophyll in Wound Healing and Suppurative Disease	Amer. J. Surgery, LXXIII: 37 (1947)
Cady, Jos. B. and Morgan, W. S.	Treatment of Chronic Ulcers with Chlorophyll	Amer. J. Surgery, LXXV: 4 (1948)
Johnson, Harold M.	Dermatologic evaluation	Arch. Dermat. & Syph. 57:348 (1948)
Langley, W. D. and Morgan, W. S.	Chlorophyll in the Treatment of Dermatoses	Penn. Med. Journal, Vol. 51; No. 1 (1947)
Rafsky, Henry A. and Kreiger, Charles I.	Treatment of Intestinal Diseases with sols. of W. S. Chlorophyll	Rev. Gastroent. Vol. 15:549 (1948)

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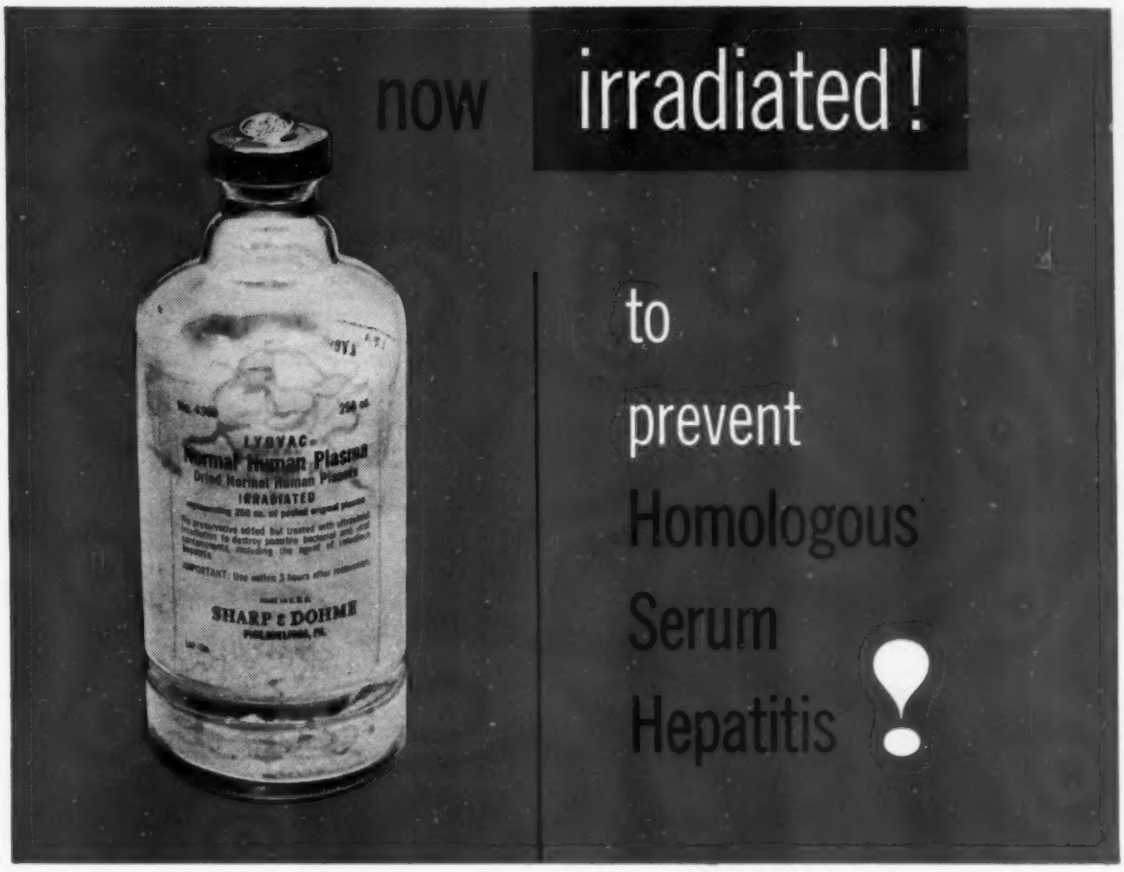

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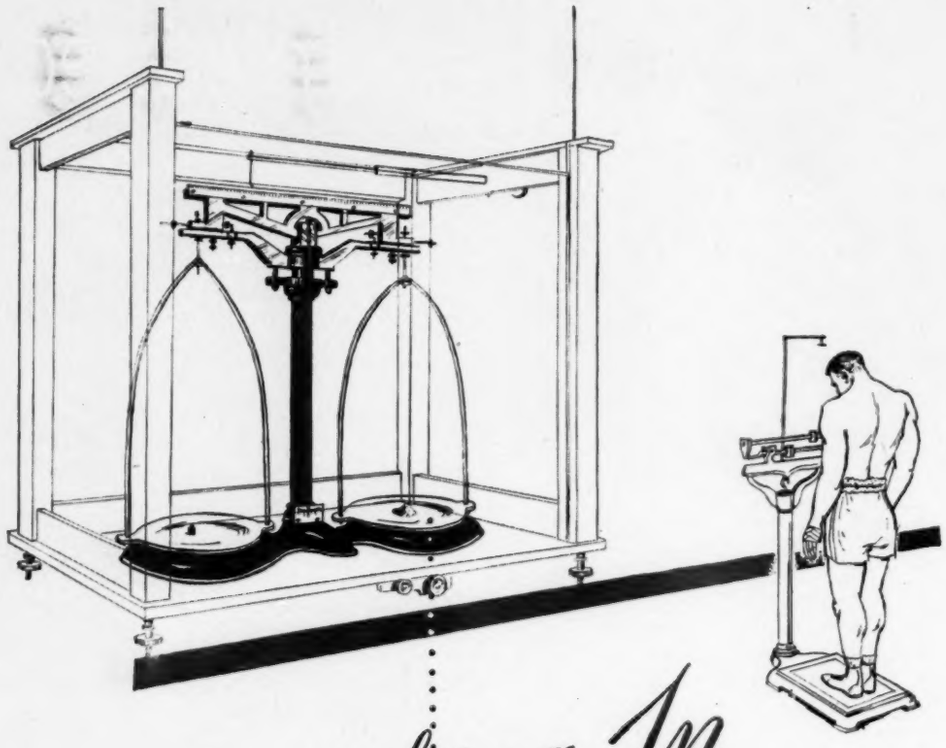

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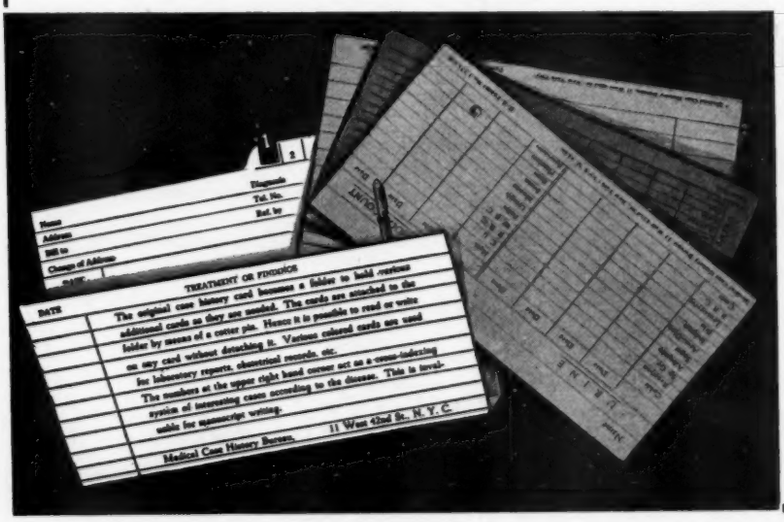
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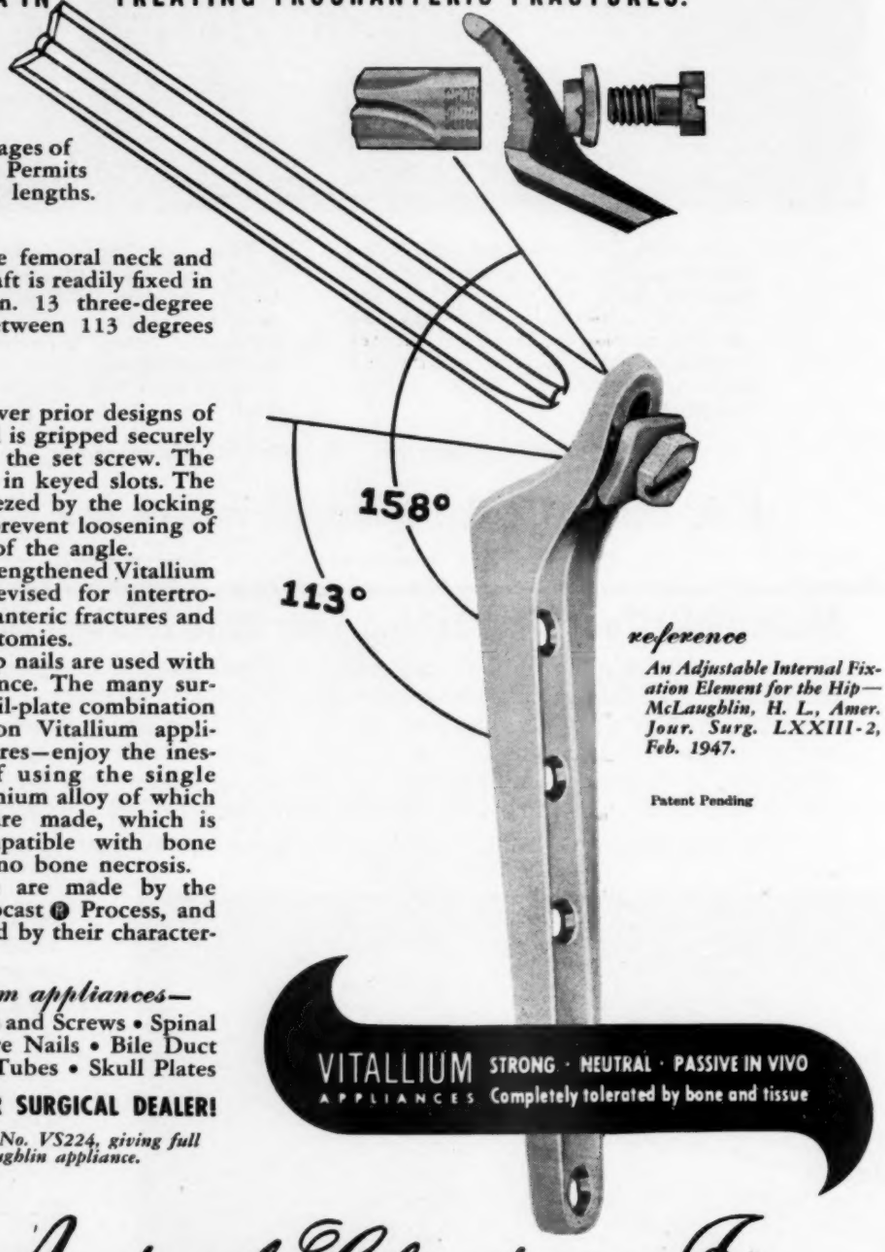

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An Adjustable Internal Fixation Element for the Hip—McLaughlin, H. L., Amer. Jour. Surg. LXXIII-2, Feb. 1947.

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To THE person who habitually skimps on breakfast, or skips this meal entirely, a well balanced, adequate morning meal can quickly prove beneficial. A breakfast providing one-fourth to one-third of the daily nutrient and caloric needs improves morning physical stamina and mental acuity. It also enhances the opportunity of the other two meals of the day to complete the satisfaction of nutritional requirements.

It is estimated that literally millions of children and adults will benefit from this simple dietary adjustment.

A good base on which to plan the morning meal is a widely acclaimed basic breakfast pattern consisting of fruit or fruit juice, breakfast cereal, milk, bread and butter. An important main dish of this breakfast is the cereal serving, consisting of cereal, milk, and sugar.

The tables show the well balanced nutrient contributions of the cereal* serving and the basic breakfast pattern. Economy, tastefulness, and variety characterize both of them.

BASIC BREAKFAST	TOTALS supplied by Basic Breakfast	AMOUNTS supplied by cereal serving
Orange juice, 4 fl. oz.;	CALORIES..... 611	202
Ready-to-eat or Hot Cereal, 1 oz.;	PROTEIN..... 20.7 Gm.	7.1 Gm.
Whole Milk, 4 fl. oz.;	CALCIUM.....0.465 Gm.	0.156 Gm.
Sugar, 1 teaspoon;	PHOSPHORUS.... 488 mg.	206 mg.
Toast (enriched, white), 2 slices;	IRON..... 3 mg.	1.6 mg.
Butter, 5 Gm. (about 1 teaspoon);	VITAMIN A..... 1074 I. U.	193 I. U.
Whole Milk, 8 fl. oz.	THIAMINE..... 0.52 mg.	0.17 mg.
	RIBOFLAVIN..... 0.87 mg.	0.24 mg.
	NIACIN..... 2.3 mg.	1.4 mg.
	ASCORBIC ACID.. 64.8 mg.	

Composite average of all breakfast cereals on dry weight basis.

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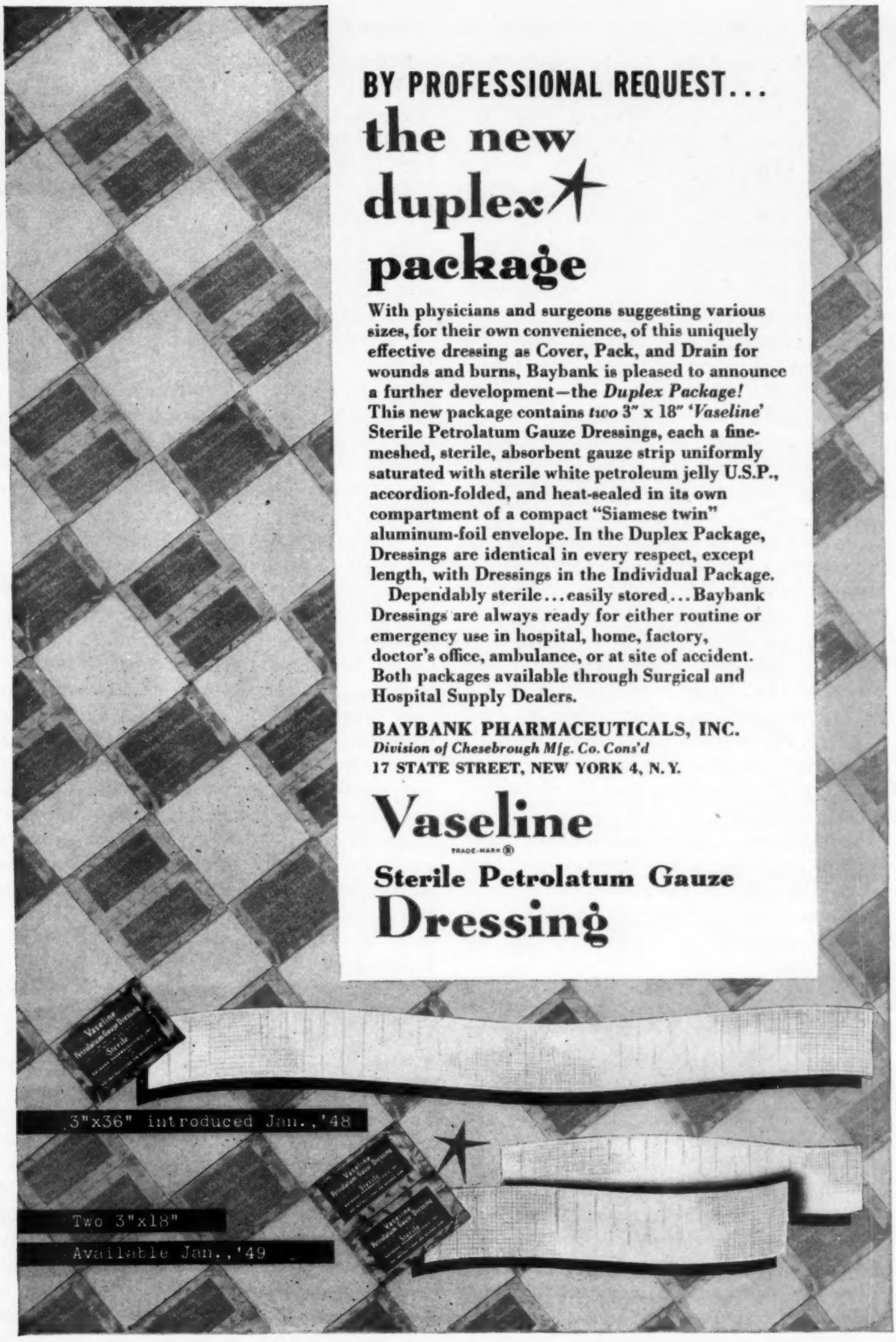

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Vaseline
TRADE-MARK ®

Sterile Petrolatum Gauze Dressing

Outside the Ivory Tower

(*continued from page 14*)

ON October 22nd Dr. Louis Bazy, Chief Surgeon of the French National Railroads, received an Honorary Fellowship from the American College of Surgeons.

Dr. Bazy came to the United States especially to receive this high scientific distinction. He has conferred with American surgeons and visited various great American hospitals, notably the Columbia and Cornell Medical Centers in New York City, the Massachusetts General Hospital in Boston, and the Mayo Clinic in Rochester, Minnesota. Dr. Bazy says that he knows of no better way to express his gratitude for the honor bestowed upon him than to show to his American colleagues a new sound film in which he and his assistants demonstrate what surgery can do to make permeable blood vessels affected by obliterative endarteritis. The operation which Dr. Bazy and his colleagues have perfected is called endarteriectomy. By this operation the vascular membrane infiltrated by arteriosclerosis can be removed on arterial walls more than 20 inches long. To do this the artery has to be button-holed on the whole length of the obliteration. The artery is then stitched. Until recently it was believed that a blood vessel deprived of its internal membrane was unfit to carry blood because the blood coagulated immediately. But Dr. Bazy and his associates have been successful in 60 per cent of cases, and the microscopic preparations they have made show the reasons for their success. This operation will surely interest American medical circles because it broadens the possibility of restoring circulation to limbs crippled by arteriosclerosis.

THE United States averages one active private physician for each 1,082 people, according to latest figures compiled by Medical Economics, the national business magazine for physicians.

FRANKLIN MEDALS, highest honors of the Franklin Institute of the State of Pennsylvania, will be awarded this year to Dr. Wendell Meredith Stanley, biochemist, and to Dr. Theodore von Karman, aeronautical engineer, according to an announcement by Dr. Henry B. Allen, executive vice-president and secretary of the Institute.

AN examination has been announced by the U. S. Civil Service Commission for filling Medical Officer positions at salaries ranging from $4,479 to $6,235 a year. The positions are located in Washington, D. C., throughout the United States and in the Panama Canal Zone, in such agencies as the Indian Service, Panama Canal Service, U. S. Public Health Service, Department of the Army, Veterans Administration, Civil Aeronautics Administration and the Railroad Retirement Board.

No written test will be required. To qualify, applicants must be graduates of a medical school and must be currently licensed to practice medicine and surgery. (The requirement of a current license will be waived for certain persons and positions.) For positions paying $4,479 and $5,232 applicants must have completed a full internship, either general rotating or in a specialty (this requirement is waived for some positions); and for positions paying $5,232 and $6,235 they must have had professional medical experience. Maximum age limits for these positions are as follows: For Panama Canal Service, forty-five years; for Indian Service, fifty years; for other agencies, sixty-two years. For persons entitled to veteran preference, the forty-five- and fifty-year age limits are waived to sixty-two years, and the sixty-two-year age limit is waived without limitation. Detailed information on requirements is given in the examination announcement. Information and application forms may be secured at most first- and second-class post offices, from Civil Service regional offices, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted in the Commission's Washington office until further notice.

THE Naval Air Reserve Training Command needs doctors. Doctors who served in the Navy during the past war and who still hold reserve commissions are requested to apply for two weeks' annual training duty or up to five months' extended duty at Naval Air Stations, it was announced by Rear Admiral Richard F. Whitehead, USN, Chief of Naval Air Reserve Training. Naval Reserve Medical Officers who can possibly spare the time are urged to apply for this duty to help alleviate the work-load at those stations which are undermanned.

(*continued on page 36*)

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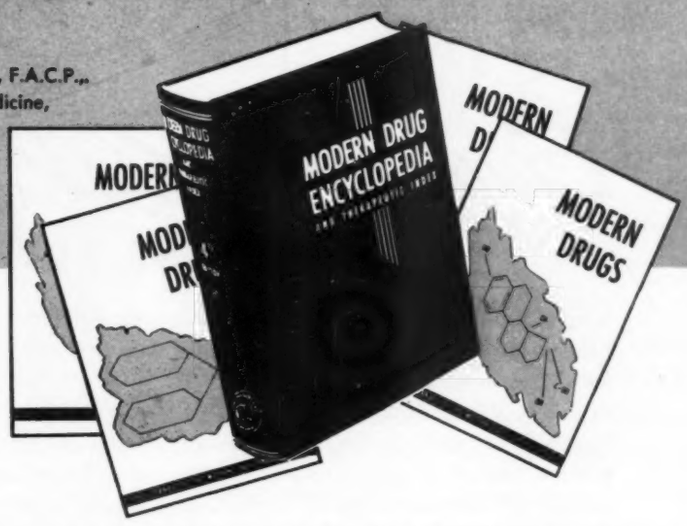

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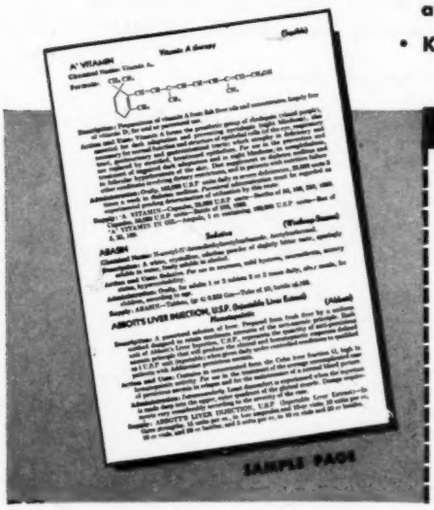
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The valuable amounts of multiple nutrients provided by three daily glassfuls of Ovaltine in milk are tabulated below.

[1] Martin, J.D., Jr.: Surgical Risk in the Elderly Patient, Geriatrics 3:296 (Sept.-Oct.) 1948.

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Three servings daily of Ovaltine, each made of ½ oz. of Ovaltine and 8 oz. of whole milk,* provide:

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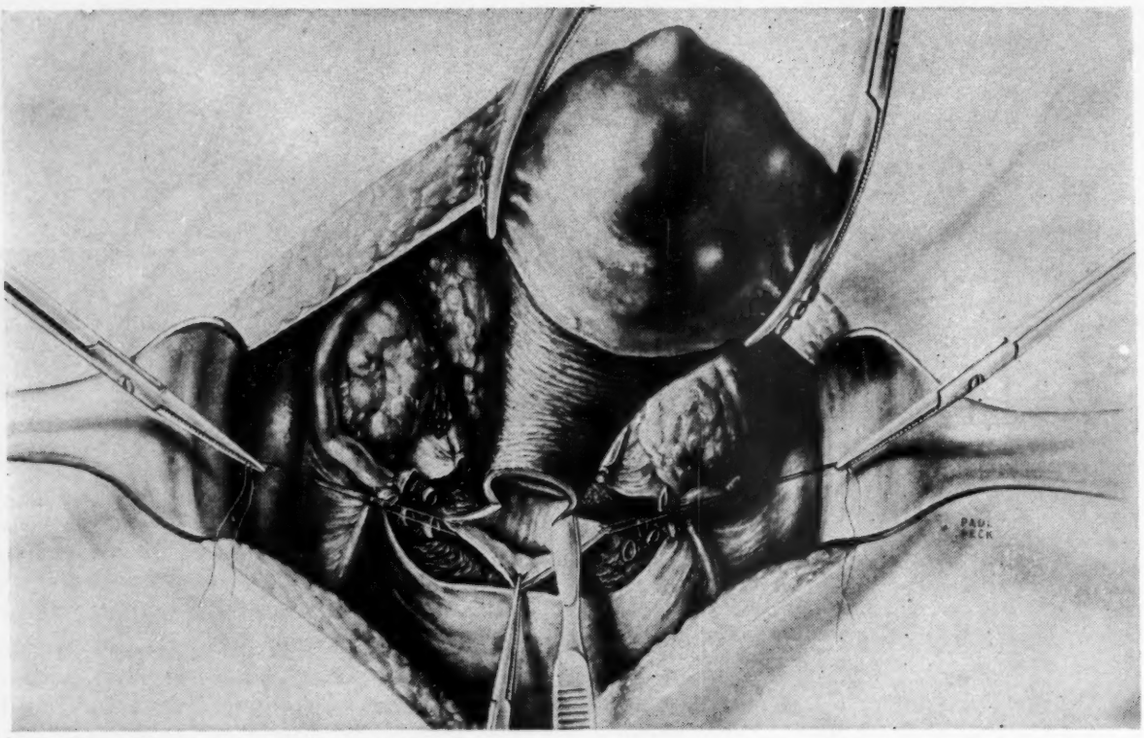

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Editorial

A PLEA FOR SIMPLER SURGICAL TERMINOLOGY

THE fact that medical literature is full of confusing terms is quite apparent to all readers. It has facetiously been said that text books are written to perpetuate past errors; and if this statement has any foundation in fact, it is to be found in most medical text books.

It is difficult enough for medical students and residents to understand the basic principles of the subject under discussion without being confused by the many terms applied to the same condition. It is my contention that in practically every branch of medicine and surgery too many proper names have been applied to certain diseases or operations. I believe that every disease should be described according to its pathology and the operation used to correct any condition should be accurately described according to the technic used. In doing this we would eliminate all proper names and everyone would readily understand the topic under discussion.

In this paper an attempt will be made to clarify and simplify the situation insofar as the subject of abdominal hernia is concerned. This subject should be one of the simplest in surgical literature but it has been made confusing because of the many unnecessary terms that have been handed down from our predecessors.

In presenting the subject to medical students or interns they need first be given a simple and concise definition of abdominal hernia which is nothing more than a protrusion of a tissue or organ through an abnormal opening in the abdominal wall. The next question to ask about a hernia is its location and its etiology. Having determined this, the only other classification necessary is whether it is reducible or irreducible and, if irreducible, is it strangulated. There is no need for such terms as incarcerated hernia which is nothing but an irreducible hernia. The term bubonocele should be discarded. Such terms as complete and incomplete hernia as well as potential or incipient hernia should suffer the same fate. Thus for example, anyone can readily understand the situation when an inguinal hernia is described as an irreducible left scrotal inguinal hernia. We know from the terminology that it is a large hernia which descends into the scrotum and is irreducible. Every other type of hernia could be described using the same simple, concise terminology.

The greatest confusion arises in discussing the types of operation used to repair hernias. Thus, we hear the names of Bassini, Halstead, Willys Andrews, Ferguson, Gallie, Wangenstein, MacArthur, Hotchkiss, Moskowitz, Blake, Mayo and many others applied to various procedures used to correct the condition. In my opinion, the student should be told the

principles involved in the cure of a hernia, namely, to reduce the contents; high ligation of the sac wherever possible or advisable and closure of the defect in the abdominal wall. If these principles are understood, it is only necessary for the student to know that various suture materials or tissue can be used to close the defect and the operation must be suited to the individual patient. Thus, in most indirect inguinal hernias a high ligation of the sac is all that is necessary. It may occasionally be necessary to use fascial sutures in direct hernias to close the defect. The source of the suture material is immaterial; and simply because the fascia is taken from the thigh or external oblique aponeurosis, is no justification for adding another name to a recognized procedure and so further confuse the young surgeon. Thus, the student will learn that in closing the abdominal defect he must meet the problem as it presents itself at operation and use the materials available if adequate and, if not, to use fascia from the thigh or elsewhere. All the above mentioned names have been applied to various procedures to accomplish the closure of the defects and in most instances each name implies only some slight modification of an antecedent operation. It seems to me that anyone understanding the above principles will find it entirely unnecessary to remember all the surgeons' names that in the course of time have been applied to certain methods of repair. There is only one method of repair of a hernia and that is ligation of the sac and closure of the defect; how this latter is done is entirely dependent on the type of tissue found during operation at the operative site; and if these tissues are not satisfactory for an adequate repair, other means must be sought and this can be accomplished by the use of fascia or flaps taken from other parts of the body, usually the thigh but this is rarely necessary.

My experience in teaching this subject to students and interns has been that they are confused by the galaxy of names and forget completely the underlying principles involved. There is no significant difference between the Halstead and Willys Andrew's operations, nor is there any great difference between the MacArthur and Gallie operations. The only difference in the latter two operations is the source of the fascia. So why should two names be applied to practically the same operation?

This confused terminology is true not only of the subject of hernia but goes throughout most of our surgical literature; and since the subject of hernia is such a simple one, it would seem to me to be a good starting point for some housecleaning in the realm of medical literature.

ROLAND L. MAIER, M.D.

Original Articles

OSTEOID OSTEOMA*

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THIS peculiar lesion has long been recognized as a true benign tumor of bone, one requiring differentiation from malignant types. Jaffe in 1935 was the first to classify it as osteoid osteoma; and while pathologists and clinicians in general have accepted this designation, Brailsford, the distinguished British roentgenologist, is inclined to regard the lesion as a low-grade cortical or subcortical bone infection. In favor of this view he advances the following arguments: (1) No known benign tumor of bone produces so marked a reaction at a distance from the wall of the tumor itself. (2) No form of accepted bone tumor can be cured by mere removal or unroofing of the tumor-bearing cavity while leaving behind surrounding reactive tissue. (3) The roentgenographic appearance does not suggest that this lesion is a benign tumor of bone; in fact, a fairly impressive group of these lesions cannot be distinguished roentgenographically from chronic sclerosing osteitis.

The authors are inclined to favor Jaffe's concept that osteoid osteoma is a benign neoplastic lesion *sui generis*. It appears as a small, ovoid, radiolucent area which is sharply circumscribed and surrounded by a far larger area of bone sclerosis. While it may be medullary in origin, it tends to appear in a cortical or subcortical position and the surrounding perifocal sclerosis is thus apt to be eccentric.

The authors' experience is based upon a group of ten cases in which the diagnosis was apparently satisfactorily confirmed.

Sex. All ten patients were males. This is a surprising observation in view of the ratio of males to females noted in other series, *e.g.*, in Jaffe's, 2 to 1; in Lewis', 8 to 3; and in Sherman's, 3 to 2. Obviously the disease has a distinct predilection for the male sex.

Age. Osteoid osteoma occurs most frequently in childhood and in early adult life. In our series the ages ranged from two to twenty years, with an average of 13.7 years; in seven of the cases the ages were from fifteen to twenty years. Lewis found the average age to be 16.1 years and more than half of Sherman's patients were between five and fifteen years old.

Clinical Findings. The principal features noted were pain, swelling and disability, present either singly or in combination, although the most constant complaint was pain. The duration of symptoms ranged from three to twelve months with an average of 5.8 months; this is shorter by far than that found by Jaffe (six months to two years) or Lewis (eleven months). While regional adenopathy was mentioned as being present in two instances, we do not regard it as significant. In all cases the past or family history was essentially negative. Local antecedent injury was mentioned only three times and we share Jaffe's viewpoint that trauma is not an etiologic factor. The lower extremity was found to be affected more often than the upper, *i.e.*, the tibia in seven of our cases. Table 1 indicates the site of involvement in the various series.

* From the Bone Tumor Department, Memorial Hospital, New York, N. Y.

FIG. 1. Tibia of twenty-three year old female with two-year history of pain, redness and swelling of left leg. Roentgenographic interpretation was osteoid osteoma but pathologic examination revealed inflammatory tissue and cultures showed the organism to be hemolytic staphylococcus aureus, thus establishing the diagnosis as bone abscess.

TABLE 1
NO. OF CASES IN SERIES

Bone Involved	Memorial Hospital	Jaffe's	Sherman's	Lewis'
Tibia	7	17	4	4
Femur	2	14	7	3
Fibula	..	6		
Humerus	..	5	1	1
Vertebrae	..	4	7	1
Phalanx	1	2	4	1
Total	10	48	23	10

Differential Diagnosis. Among the many conditions which may at times be confused with osteoid osteoma are: osteomyelitis of chronic sclerosing type, Brodie's abscess, periostitis, osteogenic sarcoma, Ewing's sarcoma (endothelioma of bone), bone repair after green-stick fracture and osteoma.

It may be extremely difficult if not virtually impossible to make a clinical or roentgenographic distinction between osteoid osteoma and chronic sclerosing osteitis, or between osteoid osteoma and a simple cortical bone abscess of the Brodie type (Fig. 1.) Roentgenographically, untreated Ewing's sarcoma is not readily confused with osteoid osteoma but osteogenic sarcoma of the sclerosing type may bear at least a superficial resemblance to it and we have seen several cases that have been referred with that diagnosis. The reparative phase of a green-stick fracture, unrecognized early in its course, may simulate fairly closely an osteoid osteoma but here, as in all of the other entities mentioned with the exception of Brodie's abscess, an area of radiolucency such as is seen in the nidus of an osteoid osteoma is conspicuously lacking.

Roentgenographic Findings. Few lesions of bone have a more consistently characteristic roentgenographic picture. Early in the course of the disease, a small radiolucent area is seen surrounded by a dense zone of opaque bony sclerosis. Later on while this area may become ossified and consequently radiopaque, the surrounding zone of sclerosis still persists. The nidus may not appear on a routine roentgenogram but may be visualized when films are taken at different degrees of penetration. With experience one may become highly proficient in the interpretation of these films. In the Memorial Hospital series a roentgenographic diagnosis of osteoid osteoma was made in nine of the ten cases; the tenth was diagnosed as chronic productive osteitis and chronic osteomyelitis.

Pathology. The histogenesis of osteoid osteoma is divided by Jaffe into three phases: (1) Initial stage characterized by prominence of proliferating and compacted osteoblasts; (2) intermediate phase in

which the osteoid is in various stages of calcification; (3) mature stage with densified trabeculae of highly calcified bone. If the lesion develops in spongiosa, it is surrounded by spongy osseous tissue and becomes sclerotic; if there is cortical development, periosteal new bone formation forms a zone of bony sclerosis.

Bacteriology. Cultures were taken in three of our cases and were consistently negative. This finding coincides with the observations of other investigators and tends to establish the fact that osteoid osteoma is not a condition that is attributable to infection by any of the common organisms.

Serology. In all but two cases of our series serologic tests for syphilis were made and were uniformly negative.

Blood Chemistry Findings. Serum calcium, alkaline phosphatase and inorganic phosphorus determinations were carried out in four cases and in every instance the findings were normal.

Treatment. In our experience the method that has yielded uniformly successful results is: complete removal by osteotome or bone chisel of the block of bone enclosing the nidus. Even incomplete curettage of this area has in some instances resulted in relief of symptoms. The main objection to curettage is that it does not provide for a definite microscopic diagnosis, which is an easy matter if a block of bone containing the entire nidus is submitted to the pathologist. A roentgenographic examination will establish the fact that the segment of bone removed contains the complete nidus. In several of our cases at the first operative attempt the nidus was either partly or completely missed and the report of the pathologist indicated sclerotic bone only. It is not always an easy matter to come down upon the exact site of the nidus and to remove it completely without sacrificing too much adjacent bone; therefore, it is wise to have roentgenograms on hand in the operating room and to take careful measurements.

We have had very little experience with roentgen therapy in this type of tumor and are unable to state its effectiveness. In general we believe that any benign lesion of bone that is accessible to surgery should be treated by that method rather than by irradiation.

CASE REPORTS

CASE I. J. O., a two and one-half year old white male, was admitted with a seven months' history of pain, disability and swelling located on the anteromedial aspect of the mid-upper third of the left tibia. No regional adenopathy was palpable. The laboratory findings were negative; serum calcium was 10.9, alkaline phosphatase 6.9 and serum inorganic phosphorus 5.08.

Provisional diagnosis: Green-stick fracture and osteomyelitis.

Roentgenographic findings reported osteoid osteoma. At operation a 5 by 3 cm. bony swelling seemingly filled with granulations was found. The lesion was treated by curettage. The pathologic report was osteosclerosis; osteoid osteoma. (Fig. 2.)

Fifteen months postoperatively the patient was asymptomatic with no evidence of recurrence of the nidus by roentgenography.

CASE II. J. L., a twelve year old male, was admitted with a six months' history of pain, more severe at night, disability and swelling of the middle and upper third of the left tibia. No regional adenopathy was palpable.

Provisional diagnosis: Osteomyelitis.

Roentgenographic findings revealed osteoid osteoma. At operation dense bone with an area of softening was located. The treatment consisted of sharp dissection and curettage. The pathologist reported osteoid osteoma.

Five months postoperatively physical examination revealed only minimal edema of the operative site. Roentgenograms showed the defect to be largely filled in and there was no evidence of a recurrence.

CASE III. S. M., a nineteen year old white male, was admitted with a history of pain of three months' duration. The lesion was located in the medial and upper aspect of the lower third of the right humerus. He had a past history of fracture of the right wrist at the age of fourteen. No regional adenopathy was palpable. The laboratory findings were negative; serum calcium 11.8, alkaline phosphatase 3.0 and serum inorganic phosphorus 3.58.

2 3

FIG 2. Case I. Appearance of lesion in a two and a half year old white male who had pain, swelling and disability of seven months' duration. The lesion so clearly visualized in this view could not be seen in the anteroposterior view; this emphasizes the necessity for taking different views from several angles and with varying degrees of penetration.

FIG. 3. Case III. Humerus of nineteen year old white male with three months' history of pain. Note characteristic nidus surrounded by zone of bony sclerosis.

Provisional diagnosis: Periostitis, osteoid osteoma.

The roentgenographic report was osteoid osteoma. At operation a firm osseous tumor was found with a 3 cm. nidus. (Fig. 3.) This was treated by sharp block dissection and curettage. The pathologist reported sclerotic cortical bone; osteoid osteoma.

The patient was asymptomatic when discharged from the hospital and it was impossible to trace him thereafter.

CASE IV. A. L. B., a sixteen year old white male, was admitted with a history of disability of seven months' duration associated with swelling of the anterior mid-third of the right tibia. The onset was alleged to have followed a fall in which the patient struck his right tibia. No regional adenopathy was palpable. The laboratory findings were negative; serum calcium 12.8, alkaline phosphatase 6.1 and serum inorganic phosphorus 3.8.

Provisional diagnosis: Sprain and osteogenic sarcoma.

The roentgenographic report was osteitis; osteoid osteoma. At operation a bony elevation measuring 4 by 3 cm. was found within which a 1 cm. lesion was noted. This was treated with sharp excision. The pathologist reported osteoid osteoma.

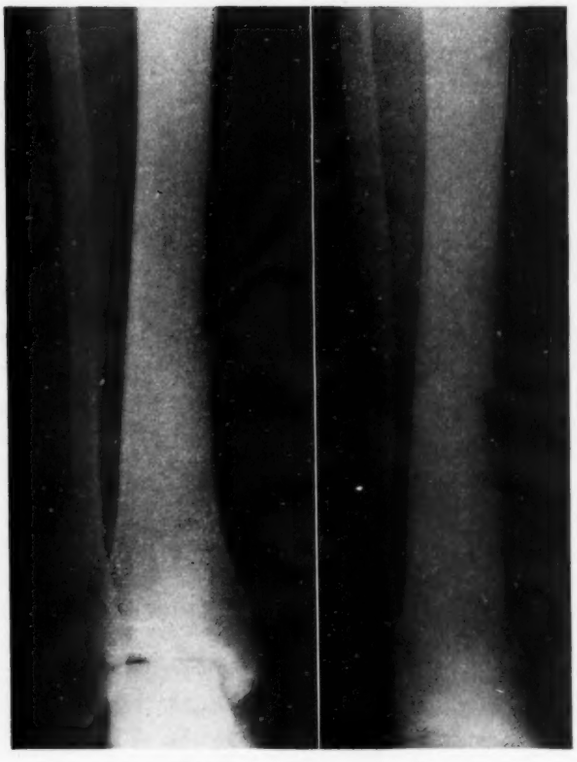
Twenty months postoperatively the patient was asymptomatic. Films made nine months after operation revealed bone regeneration, periosteal reaction and swelling of the soft parts.

CASE V. E. R., a fifteen year old white male, was admitted with a history of pain, disability and tenderness over the posteromedial aspect of the distal third of the left tibia for a period of two months. The onset allegedly followed a blow from a bowling pin.

Provisional diagnosis: Osteomyelitis, Ewing's tumor, osteogenic sarcoma.

Roentgenographically, osteoid osteoma was revealed. At operation a small area of rarefaction 1.5 by 2 cm. was found surrounded by sclerosing bony cortex and thickened periosteum. The treatment consisted of block dissection and currettage. The pathologist reported chronic periostitis; dense bone.

Seven months postoperatively physical examination showed a favoring of the affected leg with slight limping associated with pain and tenderness at the upper aspect of the wound. There was minimal edema below the operative site. Roentgenographic report seven months postoperatively disclosed an apparent increase in the process in the lower third of the tibia. Periosteal new bone was evident for a distance of 5 or 6 cm. on both edges of the tibia when viewed in the anteroposterior projection. Within the expanded area of increased density in the lower tibia there was an irregular area of decreased density measuring approximately 1 by 3 cm., within which there was a linear area of increased density (the report suggested that this might represent a bone sequestrum at the operative site). There was a soft-tissue swelling noted over the bone lesion. The roentgenographic findings were interpreted as re-



A B

FIG. 4. Case V. A, tibia of fifteen year old white male with pain, disability and tenderness of two months' duration. The lesion is seen in the distal third, posterior aspect. B, postoperative defect in case shown in Figure 4A. In this instance nidus was completely missed. However, technic of recommended excision of lesion, as seen, is sharp block dissection. A second operation was successful in completely removing the nidus.

vealing progressive changes within an osteoid osteoma that had not been completely removed at operation. (Fig. 4.)

CASE VI. R. G. H., a two year old white male, was admitted with a history of pain, disability and swelling of the anteromedial aspect of the upper third of the left tibia of three months' duration. Examination revealed enlargement of the left femoral and inguinal nodes.*

Provisional diagnosis: Osteomyelitis, Ewing's tumor, Brodie's abscess, osteogenic sarcoma, osteoid osteoma.

Roentgenographically, osteoid osteoma was reported. At operation a prominence of bone with a small nidus of soft bone was found surrounded by sclerotic bone. Treatment consisted of block dissection and curettage. The

* Reoperation was performed on March 4, 1948, when the nidus was completely extirpated; microscopic diagnosis: osteoid osteoma.

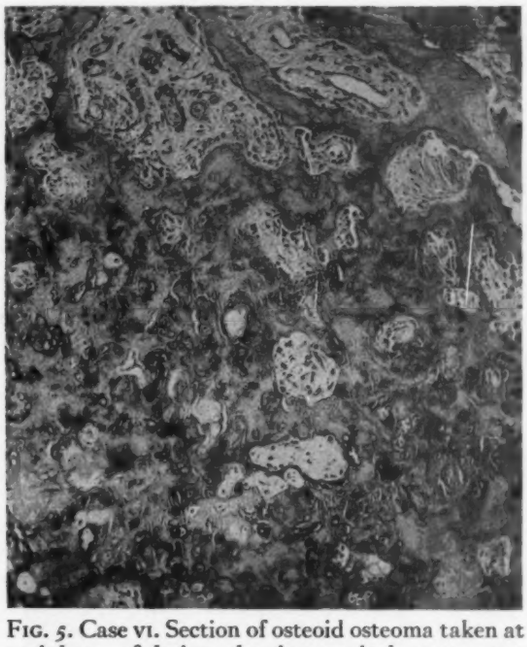


FIG. 5. Case VI. Section of osteoid osteoma taken at periphery of lesion showing typical appearance (magnification approximately 100 ×).

pathologist reported osteoid osteoma. (Fig. 5.) Culture showed no growth after five days.

Roentgenographic examination on the day of discharge showed that the nidus had been removed. The patient failed to return for follow-up examination.

CASE VII. G. A. Z., an eighteen year old white male, was admitted with a history of pain and disability of five months' duration. The lesion was located on the posterior aspect of the upper third of the right tibia. According to the patient, two years previously he had sprained his right ankle; healing required four or five months and there was some recurrent difficulty one year later. The femoral and inguinal nodes were enlarged to palpation. Laboratory findings were negative; serum calcium was 11.2, alkaline phosphatase 4.4, and serum inorganic phosphorus 4.8.

Provisional diagnosis: Osteogenic sarcoma.

Roentgenographically, the report was osteoid osteoma. At operation a bony density was found with prominence of 5 by 3 cm. with no central area of rarefaction noted. Treatment was by sharp block dissection, curettage and zinc chloride cauterization. The pathologic specimen revealed sclerotic bone.

The roentgenogram taken upon discharge showed complete extirpation of the lesion. Three months postoperatively the patient still complained of occasional pain at night and he was favoring the operative leg.

FIG. 6. Case IX. Metacarpal of twenty year old white male with swelling and pain of one year's duration. Lesion diagnosed as osteoid osteoma by roentgenographic and microscopic study of specimen removed at operation.

CASE VIII. H. M., a fifteen year old white male, was admitted with a lesion situated at the junction of the middle and upper thirds of the right femur. He complained of pain which was more severe at night and which was associated with disability over a period of five months.

Provisional diagnosis: Neuritis, bone cyst, osteogenic sarcoma.

Roentgenographic findings were chronic productive osteitis and chronic osteomyelitis. At the first operation a localized area of bone destruction measuring 5×1.5 cm. in diameter was found. The pathologist reported chronic productive rarefying osteitis, chronic fibrosing osteitis and chronic osteomyelitis. The culture showed no growth.

A roentgenogram made one month postoperatively revealed a lesion that was reported to be congenital rather than pathologic. Two years after the operation the patient still complained of occasional pain.

(Note: This patient has had three operations for pain. Because of subsequent military service it was assumed that his postoperative course was uneventful. This may be one of those cases which illustrate the need of complete extirpation of the nidus in order to obtain a cure.)

CASE IX. M. R., a twenty year old white male, was admitted with a history of pain and swelling of the proximal phalanx of the right index finger of one year's duration. No regional adenopathy was palpable.

Provisional diagnosis: Chronic productive dactylitis, osteochondroma.

The roentgenographic finding was osteoid osteoma. (Fig. 6.) At operation a 3 cm. area of bone production was found on the radial aspect of the right index finger. Treatment was by sharp block excision. The pathologist reported —osteoid osteoma. The culture from the cavity showed no growth in several days.

This case is too recent for a satisfactory postoperative evaluation.

CASE X. H. A., an eighteen year old white male, was admitted with a history of swelling and pain in the middle third and medial aspect of the right tibia of eight months' duration. The onset allegedly dated back to a kick in the right leg received while playing football. No significant inguinal or femoral adenopathy was noted.

Provisional diagnosis: Osteomyelitis, Brodie's abscess, osteoma.

Roentgenographically, osteoid osteoma was found. At operation a small tumor was located. This was treated by a sharp block excision. The pathologist reported—osteoid osteoma. Culture revealed no growth in five days.

The patient was asymptomatic on discharge. A postoperative roentgenogram revealed that the excision had failed to include the entire nidus area.

SUMMARY AND CONCLUSIONS

Osteoid osteoma is a well defined, localized, monostotic bone lesion, probably of benign origin, rather than a chronic subperiosteal bone abscess; its etiology is still uncertain. It has a predilection for the long bones of males in their second decade. It consists of radiolucent nidus, measuring from 1 to 2 cm. in diameter, surrounded by a circumscribed zone of sclerotic bone which fades out into normal bone. This perifocal zone may be eccentrically placed and may sometimes, but not always, alter the contour of the affected bone.

Because osteoid osteoma gives rise to symptoms of pain, tenderness, disability and sometimes mild swelling, it has been, and doubtless will continue to be, mistaken either for early sclerosing osteogenic sarcoma or for circumscribed bone abscess.

The radiolucent area which represents the nidus is not always apparent on routine roentgenograms; and when not seen, the condition may be regarded as sclerosing osteitis of Garré. Films made with varying degrees of penetration will nearly always reveal the nidus.

Treatment consists of removal of the nidus *en bloc*. This completely relieves the symptoms and also permits an accurate diagnosis since it is the osteoid tissue of the nidus itself which is characteristic of the disease. If the operator misses the nidus and resects merely a segment of adjacent sclerotic bone, the symptoms will persist; but relief will be obtained if the overlying cortical bone is unroofed and the nidus exposed and curetted. In every case it is important to close the wound in layers without drainage.

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TRIPLE ARTHRODESIS*

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Medical Corps, Army of the United States

THE value of triple arthrodesis in treatment of traumatic subtalar arthritis following fractures of the calcaneus has been established. It is the purpose of this brief report to confirm previous experiences and to advocate the procedure in the definitive treatment of fractures involving the proximal tarsal joints. Observations were made in a series of eighty-two cases, mostly war compound injuries, operated on at Fletcher General Hospital, Cambridge, Ohio during a one-year period (November 1, 1944 to November 1, 1945).

Indications. Indication for operation was a painful foot following a simple or compound fracture involving any or all of the proximal tarsal bones and their joint surfaces: talus, calcaneus, cuboid and navicular. The procedure was not performed until a thorough tryout of unprotected walking for a period of one or two months was made. In compound fractures cessation of all drainage was required.

Technic of Operation. Either the Kocher or the anterolateral approach was used. The sinus tarsi was cleaned out. The surfaces of the calcaneocuboid, talonavicular and subtalar joints were thoroughly denuded of cartilage. Corrective wedges were removed if indicated. The sinus tarsi was filled with bone chips obtained from the anterior portion of the calcaneous and other available bone. An attempt was made to obliterate the remaining dead space in the region of the sinus tarsi with soft tissue without using too many deep sutures. The skin was closed with continuous or interrupted sutures of silk, dermal or wire. The foot was immobilized in a long leg plaster cast with the heel in a neutral or slight valgus position, the ankle at 90 degrees dorsiflexion and the knee in extension.

Postoperative Course. The plaster cast was immediately split throughout. High elevation was ordered to minimize the swelling. Two weeks postoperatively an unpadded long leg cast was applied; adjustments of position were made at that time without anesthesia. The patient was allowed up with crutches without weight bearing until six weeks from the date of operation. The long leg cast was then changed to an unpadded walking boot in which the patient walked for another six weeks preferably without any external support. The use of crutches was strictly prohibited. Occasionally the walking boot was applied after the first change of plaster two weeks postoperatively. The plaster cast was removed three months from the date of operation. The patient was immediately instructed to walk using a firm low-quarter shoe. An Ace bandage and a longitudinal arch support were supplied. Physiotherapy was instituted with stress on active walking exercises, mostly given in the remedial gymnasium. Treatment was carried out for four to eight weeks after removal of the cast. The patients were then routinely separated from military service with a certificate of disability for discharge.

Observations. A strictly statistical evaluation of the results does not seem indicated since none of these patients were observed longer than a few months after operation. The following facts, however, are of interest: All the patients stated that they were improved by the operation. Improvement was determined by relief of pain while walking, particularly over uneven ground, and by disappearance of swelling and edema. Limps were eliminated

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or at least markedly improved. Arthrodesis of the involved joint alone resulted in persistent pain and had to be followed later by triple arthrodesis. X-ray examination three months postoperatively showed bony fusion of the involved joints in almost all cases. In the few cases in which fusion was not complete by x-ray the result still seemed to be satisfactory. Disappearance of the osteoporosis which had existed prior to operation was noted. There was no difference in the healing between the two types of incisions used. In several instances drainage and skin necrosis were found at the first and sometimes the second change of plaster, but in all but one patient healing of the wound was complete at the end of three months. This applied in cases in which initially a considerable breakdown of a scar (in compound fractures) occurred. The insertion of bone chips into the sinus tarsi was found to be of great value in obtaining fusion of the subtalar joint. Postoperative immobilization of the leg with the knee in complete extension was prompted by the earlier disappearance of edema than when the knee was immobilized in the flexed position. No difficulty was seen in correcting the alignment of the foot without anesthesia two weeks after the operation. The position of the heel seemed to be less important than previously believed. It appeared that a heel in neutral position resulted in a better gait than a heel in valgus position. Varus position was considered undesirable because of a poor gait. Unsupported weight bearing in a well applied unpadded walking boot according to the Boehler technic had a decided influence on the amount of swelling following removal of the plaster cast and the ability to walk. There was no difference in the results when the walking cast was used two weeks after operation. More than 80 per cent of the patients stated that they derived more benefit from walking exercises than from physiotherapy consisting of heat, massage and whirlpool. The latter treatment was continued only for experimental purposes. Use of an arch support was generally justified by improvement in the patient's gait and comfort. If the arch support caused discomfort, it was immediately discontinued. In a large number of cases the end result was so satisfactory that it appeared hardly justifiable to discharge the patient on a certificate of disability for discharge. In the earlier phase of the war the patient had been returned to duty.

CONCLUSION

Observations in a series of eighty-two cases of triple arthrodesis have been reported. The procedure has proved to be of excellent value in treatment of a painful foot following a fracture involving any of the proximal tarsal joints.

TREATMENT OF FRACTURES OF THE FOREARM WITH INTRAMEDULLARY PINS*

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AT the outset we must emphasize that most fractures of the shaft of the radius and ulna can be treated satisfactorily by closed manipulative methods or with some form of traction. Only a relatively small per cent of forearm fractures require open reduction and internal fixation. Even so normal function of the hand and forearm is dependent upon almost exact replacement of fractures of the long bones. Hence, in deciding upon the method of treatment it is not only essential to restore the fragments to normal position but to ensure preservation of the interosseous space between the radius and ulna. Forearm fractures which are difficult to reduce by closed methods or in which there is a likelihood of redisplacement during the period of healing are: (1) Transverse fractures of the shaft of one bone with overlapping of the fragments; (2) oblique fractures of a single bone with displacement; (3) comminuted fractures of one or both bones; (4) multiple fractures at different levels in the same bone; (5) irreducible fractures with overlapping; (6) Monteggia fractures (fractures of the upper third of the shaft of the ulna with anterior displacement of the head of the radius).

Complicated fractures of the forearm in which it is impossible to correct the displacement usually require open reduction with some type of internal fixation. Sometimes in transverse fractures open reduction alone with levering of the fragments until they become engaged is successful. Wire loops about the fragments or screws across the fracture line may be satisfactory in long oblique fractures. In some fractures which are not markedly comminuted application of metal plates and screws to the bones will secure the fragments in proper position. However, it has been common experience that after such open reduction and internal fixation operations there is a strong tendency toward non-union of the fracture or the occurrence of low grade infection in the wound. In addition extensive dissection required to replace the fragments and to insert the internal fixation appliance often interferes with the blood supply to the fracture and delays healing of the bone. The necessarily wide exposure leaves a large scar which is often adherent to the bone. A metal plate applied to a subcutaneous bone such as the ulna may also produce a tender pressure point unless it is placed beneath the muscles. Finally, it is inadvisable to introduce plates and screws in the bones of young children for fear of interfering with their normal growth. Consequently, none of these methods of internal fixation has been universally applicable and various alternative procedures have been devised to immobilize the fracture fragments in good anatomic position without leaving large fixative applicances in the body.

Use of removable intramedullary wires and pins seems to offer a happier solution to these problems than anything that has been tried thus far. Forty years ago Lambotte, the great pioneer in operative treatment of fractures, experimented with intramedullary wires in fractures of the clavicle. In 1921 Hey-Groves reported the use of a steel pin in the medullary cavity for comminuted fractures of the femur. During the past few years Rush, Lambrinudi, Dickson, Murray, Souer and Kuntscher have revived

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A B

FIG. 1. A and B, F. M. S., a male, seventy years of age; oblique fracture of the distal third of the shaft of the ulna with tear of the distal radio-humeral ligaments.

interest in this method as an effective substitute for other types of internal fixation. In World War II German surgeons used Kuntscher's intramedullary pins extensively and they were brought to the attention of American surgeons when prisoners of war were liberated with such appliances still in the bones.

The technic of insertion of intramedullary wires and pins has so improved that the method has now become well standardized. While they have been used in fractures of the femur, tibia, humerus and forearm bones, this paper will only discuss their use in the forearm. Advantages of intramedullary fixation of fractures of the radius and ulna are: (1) Only a small incision is required; (2) there is only slight bleeding at the time of the operation and therefore little shock; (3) there is little dissection of the periosteum from the fracture fragments; (4) danger of infection is minimized because of the smaller wound. (5) The probability of union of the fracture is increased because the pins hold the fragments together even though some absorption of the bone ends takes place.

Kirschner wires of various diameters are well suited to the forearm bones although the larger and less flexible wires are generally preferable. Long, slender, Steinmann pins are also useful in the ulna because such wires and pins produce little trauma to the bone marrow and are unlikely to cause fat embolism. (Figs. 1 to 5).

In preparation for such an operation the patient is placed on his back on the operating table with the forearm held across the chest. A tourniquet about the upper half of the arm provides a bloodless field and simplifies the procedure. After the skin is sterilized drapes and towels are fastened about the middle of the arm and over the wrist and hand thus leaving the olecranon in view. The towel about the wrist and hand is bound with sterile gauze bandage so the hand can be manipulated during the operation. After the incision the usual aseptic precautions are observed by draping the skin edges with towels or a stockinette before any dissection takes place in the subcutaneous tissues. A small incision about 1½ to 2 inches long is made over the site of each fracture and the soft tissues are separated bluntly to the bone. Any loose strands of soft tissue between the bone ends are dissected free and removed. In fractures of the shaft of the

A B

FIG. 2. F. M. L., a male, ten years of age. A, oblique fractures of the shafts of the radius and ulna with overriding and displacement. Fragments had been manipulated on two occasions without achieving successful reduction. B, postoperative roentgenogram showing satisfactory replacement of radius and ulna and fixation with curved Kirschner wires.

ulna the proximal fragment is lifted into the wound with a bone clamp and a wire or pin is drilled through it until it penetrates the end of the olecranon and the end of the wire is opposite the fracture. The proximal fragment is again placed opposite the distal fragment and manipulated until normal alignment is gained. The end of the wire or pin at the fracture line is then pushed back with pliers into the medullary cavity of the distal fragment. After it is driven into the distal fragment for 2 or 3 inches the end projecting from the olecranon is cut off with about ½ inch projecting from the skin. If desired, the end of the wire may be cut flush with the skin so that there is no projection. When this is done, however, there is danger that the wire may "migrate" so that it cannot be removed later.

In fractures of the proximal end of the ulna with displacement of the head of the radius it is preferable to use a Steinmann pin rather than a wire since this provides more rigid lateral support and prevents angulation. The head of the radius can then be manipulated into its normal position without danger of dislodging the ulnar fracture. In fractures of the middle of the shaft of the ulna a long wire is generally sufficient, particularly if the distal end engages the cancellous bone in the end of the ulna. In fractures of the distal third of the ulna there is generally some tear of the radioulnar ligament at the wrist. A long Steinmann pin provides adequate support in such cases while subsequent manipulation of the hand into ulnar deviation restores the normal relationship between the lower end of the radius and the ulna. The ulna is essentially a straight bone so any type of rigid wire or pin is suitable

A B

FIG. 3. J. L. B., a female, thirty-six years of age. A, comminuted fracture of the shaft of the ulna, fracture of the olecranon and fracture of the head of the radius with displacement. B, postoperative roentgenogram showing fixation of the fractured olecranon and ulnar shaft with single Kirschner wire. Radial head was removed at the time of the open reduction of the ulnar fractures.

because sufficient purchase is gained on the distal fragment. The wire or pin prevents angulation and displacement of the fragments while the cast applied after operations prevents rotation of the forearm. When both the radius and ulna are fractured, it is technically better to reduce the ulna first and secure it with the intramedullary wire before reduction of the radius is attempted. Intramedullary wires in the ulna are generally left in place for six to eight weeks after which they can be easily extracted with pliers.

In reducing fractures of the shaft of the radius it must be borne in mind that the radius is a curved bone and that this curved position must be restored in order to preserve the normal interosseous space and rotation of the forearm. Therefore, since the radius is curved, a long straight wire or pin cannot be inserted from one end of the bone to the other as in the ulna. An incision is made over the fracture of the shaft of the radius as was described for fractures of the ulna. In this case, however, the incision is extended about 2 inches on one side of the fracture in order to provide a site for insertion of the wire into the medullary cavity. In fractures of the proximal half of the shaft of the radius the incision is extended distally in order to insert the wire from the distal fragment. In fractures of the distal half of the radius the incision is extended proximally in order to insert the wire from the proximal fragment. The soft tissues are dissected to expose the fracture line and the fragments are levered into normal relation to each other. About 2 inches proximal or distal to the fracture a large hole is drilled obliquely through the cortex into the medullary cavity. It is important that this hole should be $\frac{1}{8}$ or $\frac{3}{16}$ inches in diameter in order to facilitate the insertion of the wire. A stout Kirschner wire is "sprung" with the fingers to form an arc. The blunt end of the curved wire is then inserted through the oblique hole in the cortex and with pliers or a light mallet it is forced through the medullary cavity to the point of the fracture. Fragments are then held in normal relationship to each other with a bone clamp and the wire is pushed into the opposite fragment. The curve in the wire

A B

FIG. 4. F. M. D., a female, thirty years of age. A, fracture of the upper third of the shaft of the ulna which was inadequately secured with short plate and screws with resulting non-union. B, post-operative roentgenogram after fracture was exposed, bone plate removed, bone ends freshened and cortical bone graft applied. Fragments immobilized in good position with single Kirschner wire.

A B

FIG. 5. L. J. D., a male, twenty-five years of age. A, old fracture of both bones of the forearm with non-union. Previous cortical bone graft to each bone with development of second non-union. B, Postoperative roentgenogram showing forearm bones held in perfect position by single Kirschner wire in the ulna. Former bone grafts removed from each bone, ends freshened and new grafts applied. Screw fixation of graft to radius. (In subsequent cases curved Kirschner wire was found more suitable for immobilization of the radius.)

provides a secure grasp on the fragments so that it does not need to project into the medullary canal of either fragment more than 2 or 3 inches. The end of the wire which projects from the wound is cut off about ½ inch from the skin and the wound is closed about it. It is not advisable to bend the end of the wire so that it can be covered with the skin for in so doing the fragments may be moved out of position or the ends of the bones may be fractured.

When there are several fractures in the shaft of the radius or ulna, the wires can be "threaded" through the fragments like a string through beads. If there is extensive comminution at the site of the fracture, the loose fragments are moulded about the wire and held in place by the soft tissues which are sutured over them. After the wires are in place in the radius and ulna and the projecting ends are trimmed, the wounds are closed and covered with light dressings. A plaster cast is then applied from the base of the fingers to the shoulder with the elbow flexed 90 degrees to prevent rotation of the forearm. The wrist is supported in dorsiflexion and in cases of ligamentous tears at the wrist the hand is held in ulnar deviation. In Monteggia fractures it is necessary to immobilize the elbow in acute flexion in order to retain the head of the radius in its proper position. The cast is worn six to eight weeks, depending upon the age of the patient and the degree of comminution of the fracture. At the end of that time the cast is removed, the wires are withdrawn and roentgenologic examinations are made to determine the progress of healing. The forearm may also be grasped to test the union by determining the amount of resistance to bending. If the fractures are not solidly healed or if they do not resist bending, another similar cast is applied for an additional month.

In nineteen cases in which we have treated fractures of the shaft of the bones of the forearm by the use of intramedullary wires and pins we have had only two failures. One patient was an epileptic who, while wearing the cast, suffered several very severe falls which caused non-union of the ulna. The other failure was in one of the earlier patients in whom the wire in the radius was not inserted properly in the distal fragment. In general when the fragments were well reduced, the wires provided perfect fixation with a minimum of interference with bony union. However, solid bony union was seldom present in less than three months.

Intramedullary wires or pins probably should not be used in compound fractures because of the danger of introducing infection into the marrow cavity of the bones. In old fractures with malunion or non-union wires are useful for supporting bone ends after osteotomy and bone graft operations. In any case in which a cast is applied from the fingers to the shoulder for two or three months it is important to advise the patient of the need for constant exercise of the shoulder and of the fingers. If this is not done, the long fixation may result in some permanent stiffness or pain in the shoulder. Stiffness of the fingers may also follow unless the thumb is left free in the cast to permit normal grasping exercises of the hand.

Our experience with this method of fixation of fractures of the forearm covers several years and convinces us that it offers a better chance of union and less danger of infection or non-union than any of the previous methods of operative treatment. It is comparatively simple and the results have been far better than they were following other standard procedures.

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FRACTURES OF THE NECK OF THE ASTRAGALUS

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FRACTURES of the ankle region are of frequent occurrence in general practice as far as the tibia and fibula are concerned. To a much lesser extent fractures of the os calcis are encountered. On occasion, severe injuries of the foot are seen in which both the talus and os calcis are involved, but it is quite uncommon to have a fracture of the astragalus only.[4] When only the astragalus is injured, the most common site is in the neck.[6] These fractures, on the whole, constitute a serious type of injury because of the frequency of either a partial or complete dislocation of one or more fragments, usually the body. The high incidence of some type of dislocation is attributed to the fact that the astragalus has no muscular attachments and that three-fifths of its total surface area is articular in nature.[2]

Disabling sequelae are frequent following injury to the talus due to its position as a component of one of the major weight-bearing joints of the body. The complications subsequent to accurate reduction usually result from poor blood supply and poor healing of cartilage in general. The blood supply is dependent on numerous small vessels as it has been shown that there are no major nutrient vessels.[10] It is at once apparent that an avascular or aseptic necrosis is easily possible and, indeed, it does occur all too frequently, subsequent to dislocation or after open reduction. The second major disability is a resultant arthritis due to an overgrowth of callus or the absorption of bone underlying a portion of the articular surface. The pain may be so severe and prolonged that it can be relieved only by a fusion of the joint involved.

Treatment of such fractures is dependent on the degree of displacement and may readily be classified under four general groups:

1. Fractures of the neck without displacement are simply and satisfactorily treated by plaster immobilization extending from the metatarsal-phalangeal joints to the tibial tubercle with the foot at a right angle for a period of ten to twelve weeks.

2. Fractures with impaction, but no dislocation, present a difficult problem; reduction, although occasionally successful by a closed method, more often requires operative intervention. Sawyer[8] in 1930 reported three cases of impacted fractures of the astragalus and recommended in case of second degree impaction use of an osteotome inserted into the neck and rotated until the normal relations of the astragaloscaphoid joint were restored. However, when a satisfactory reduction is not obtained either by a closed or open procedure, an early arthrodesis as recommended by Miller and Baker[6] should be done.

3. Fractures with partial dislocation of the body involve the subtalar joint, a fact which is often overlooked in the process of reduction. A satisfactory position may often be obtained by a closed procedure and offers a much better prognosis than open intervention. Under spinal anesthesia, because of the need of as much muscular relaxation as possible, the foot is forcibly plantar flexed while applying traction in the axis of the tibia. The foot is then rotated laterally and medially to break up any impaction present. Pressure is then applied by the operator to the lateral and medial aspects of the astragalus while the assistant slowly dorsiflexes the foot to a right angle. X-rays are then taken to check the reduction; if it is incom-

plete, the procedure is repeated. If satisfactory, a plaster cast is applied from the metatarsal-phalangeal joints to the tibial tubercle with the foot at a right angle. This was the procedure carried out in two of the presented cases with complete maintenance of position which is in agreement with Montgomery[7] who states that if accurate reduction is obtained, the position can be maintained with the foot immobilized at a right angle.

Special emphasis, according to Watson-Jones,[11] should be placed upon accurate reposition of the subtalar joint which may be inadequately reduced even though apposition of the fractured surfaces of the astragalus appear excellent. In cases in which this is in evidence placing the foot in plantar flexion may correct the remaining dislocation of the joint. If this is done, the cast should be changed in two or three weeks at which time the equinus is corrected.

If closed reduction is impossible, immediate open reduction is indicated because of early degeneration which may occur. Bonnin[2] believes that after forty-eight hours results are bad and he advocates reduction as soon as possible. The technic of exposing the site of fracture is well stated by Campbell.[3] Internal fixation of one type or another may be indicated to maintain reduction.

4. Fractures with complete dislocation of the body of the talus are a most serious problem. Closed reduction is practically impossible and early surgery is indicated. Unfortunately, injuries of this type are frequently associated with marked soft tissue damage, such as abrasions, contusions or avulsion. When open reduction is done, it may be necessary to make incisions, both anteriorly and posteriorly, according to Miller and Baker,[6] removing the displaced fragment through the posterior incision and replacing it through the anterior incision. This was required in the case of this type presented herein. Results of treatment are often poor when only reduction is done. Many authors [5,9] recommend that if reduction is impossible, a fusion of one type or another of the ankle joint should be done. Blair[1] in 1943 reported excellent results in two cases in which he fused the tibia and the undisturbed neck of the astragalus by means of an anterior sliding tibial bone graft after removing the fragmented body.

The question of astragalectomy in fractures of the astragalus is controversial. It is true that fusion of the ankle is not always a simple or a successful procedure, but when successful it does offer a fixed condition in which deformity should not increase. Astragalectomy offers a simple procedure, but a greater shortening of the extremity is combined with the possibilities of further deformity developing.[1] Furthermore, a fusion is free of painful movement whereas astragalectomy may require later fusion for deformity and pain. As a consequence it would appear logical to arthrodese this fracture if, primarily, a satisfactory reduction is impossible or if evidence of avascular necrosis appears following successful closed or open reduction.

CASE REPORTS

Case I. A white male aged thirty-two injured his right ankle on November 8, 1943, when the roof of a dugout upon which he was standing collapsed. X-ray demonstrated a simple complete fracture of the neck of the astragalus, without displacement. (Fig. 1.) A plaster cast was applied; on January 15 the cast was removed. (Fig. 2.) Examination on March 27th demonstrated full motion of the ankle in all directions and the patient was free from symptoms; he was returned to full duty.

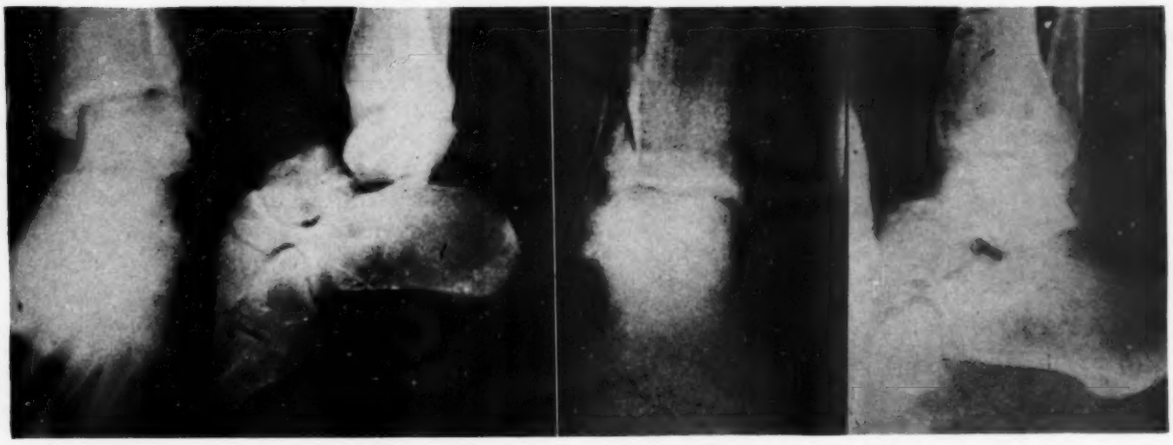
Case II. A white male aged twenty-one injured his left ankle on October 5, 1944, when his rifle accidentally discharged; the bullet passed through the medial border of the tibia at the level of the internal malleolus and out the center of the plantar surface of the foot. (Fig. 3.) Three hours after injury a débridement was done under general anesthesia. Several small bone fragments and pieces of leather were removed from the bullet tract. A thorough irrigation with Dakin's solution was followed by insertion of a Dakin tube

1 2

FIGS. 1 and 2. Case I. January 8, 1943, simple fracture of the neck without displacement; January 15, 1944, satisfactory union.

3 4

FIGS. 3 and 4. Case II. October 5, 1944, comminuted fracture of the neck of the astragalus. December 1, 1944, union in satisfactory position.



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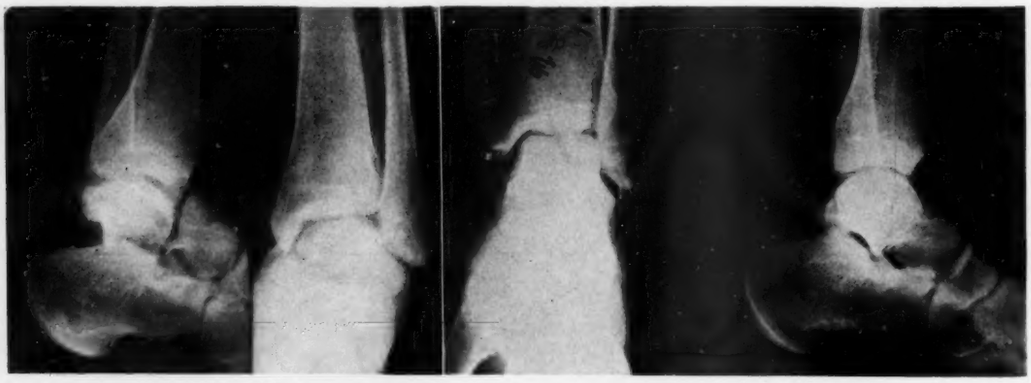
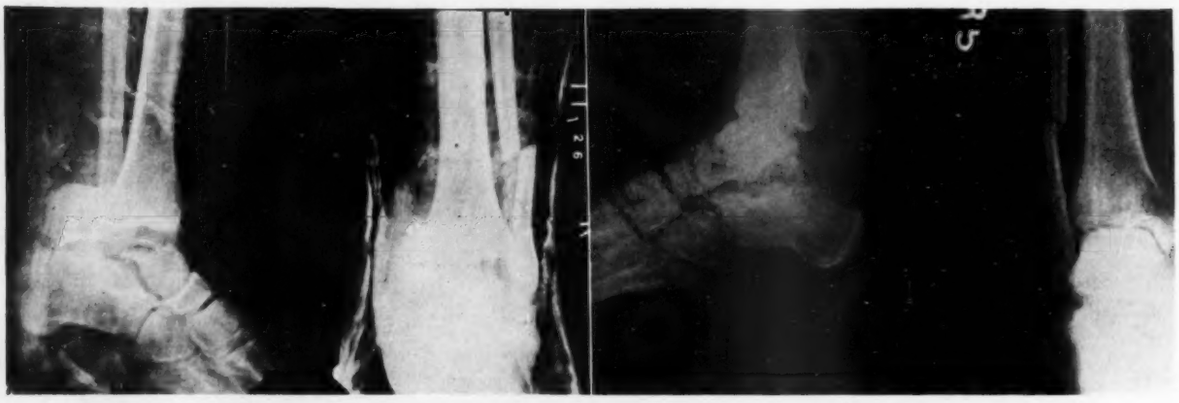
FIGS. 5 and 6. Case III. April 22, 1944, complete fracture of the neck with partial dislocation of the body. June 17, 1944, satisfactory position and union.



7 8

FIGS. 7 and 8. Case IV. August 25, 1945, complete fracture of the neck with partial displacement of the body; September 8, 1945, satisfactory position and alignment.



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FIGS. 9 and 10. Case V. Complete fracture of the neck with posterior dislocation, complete, of the body; aseptic necrosis following open reduction.

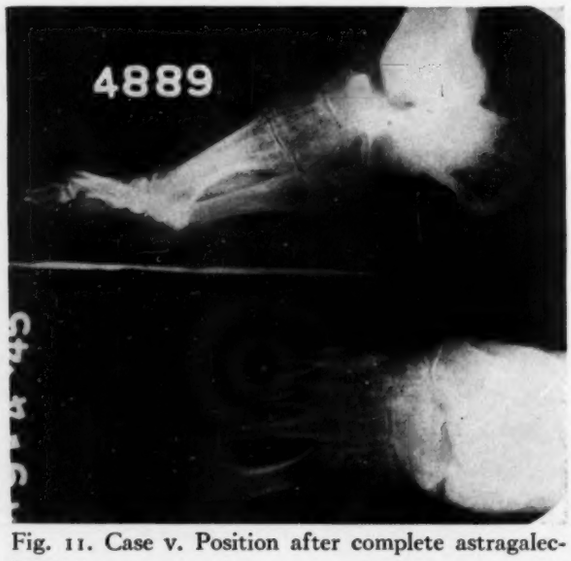

Fig. 11. Case V. Position after complete astragalectomy.

through the point of exit up into the tract. Vaseline gauze was then packed around the tube and a plaster cast was applied up to the tibial tubercle. Injections of penicillin were given twice daily through the tube and therapeutic doses of sulfadiazine were given by mouth for five days. On October 18, 1944, the cast was removed and all wounds were found healed. The final cast was removed on December 1, 1944, at which time there was good union. The patient returned to duty on January 1, 1945. (Fig. 4.)

CASE III. A white male aged twenty-seven injured his right ankle on April 21, 1944. While playing basketball, he jumped into the air for the ball and landed on the ball of his foot. Roentgenologic examination revealed a simple complete fracture of the neck of the right astragalus, with partial dislocation of the body. (Fig. 5.) On April 22, 1944, a closed reduction was performed and a plaster cast was applied holding the foot at a right angle. On April 25, 1944, a walking caliper was applied. On June 17, 1944, the cast was removed and physiotherapy was started. (Fig. 6.) The

patient returned to full duty on August 24, 1944, with no complaints or disability.

CASE IV. A white male aged eighteen injured his left ankle August 25, 1945, when he slipped and fell down on embankment for a distance of 6 feet, twisting his left foot. X-ray revealed a simple complete fracture of the neck of the left astragalus, with partial displacement of the body. (Fig. 7.) On August 26, 1945, a closed reduction was performed and a plaster cast was applied up to the tibial tubercle, holding the foot at a right angle. Postreduction swelling necessitated splitting the cast anteriorly. On September 7, 1945, a new cast was applied. X-rays taken at this time revealed maintenance of reduction. (Fig. 8.)

CASE V. A white male aged twenty-five sustained a fracture of the neck of the astragalus with complete displacement of the body. (Fig. 9.) Closed reduction was unsuccessful and open reduction was performed. The body of the astragalus was removed through a posterior medial incision with replacement through an incision on the dorsum of the foot. (Fig. 10.) Non-union and osteomyelitis occurred together with an aseptic necrosis of the body. Complete astragalectomy was done. The wound healed but subsequently a sinus with purulent drainage manifested itself. A small sequestrum was later extruded and the wound healed. Spontaneous fusion with the foot in slight equinus resulted, with shortening of the extremity but complete freedom from pain. (Fig. 11.)

CONCLUSION

1. Fractures of the neck of the astragalus with or without displacement often may be treated successfully by closed methods.
2. Early adequate reduction whether by closed or open method is essential.
3. In cases in which reduction is unsuccessful or an aseptic necrosis occurs a fusion of some type is indicated.

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USE OF A QUATERNARY AMMONIUM COMPOUND FOR THE SURGICAL SCRUB*

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SINCE the time of Semmelweis and Oliver Wendell Holmes surgeons have been interested in perfecting a method for cleansing their hands. Under the influence of the philosophies of Lister the ideal goal has become the complete and lasting sterilization of the skin, both of the patient and of the hands of the surgical team. To approach this goal a multiplicity of cleansing and antiseptic agents[43] has been employed and the ritual of the surgical scrub has become deeply entrenched in the lore of the art. It was recognized early that this ritual was significantly ineffective. Since Bloodgood first began to wear rubber gloves in Halsted's clinic, the gown and glove have remained the sartorial trademark of the surgeon. Recently Lovell[22] scientifically demonstrated what many have long suspected, that by the use of surface agents perfection in the sterilization of skin (as in everything else) is impossible and must remain, as it always has been, a goal and a standard for relative comparison.

Because of intrinsic defects in existing methods of analysis, however, the relative merits of various scrub routines remained in the arena of mysticism until Price[42] in 1938 published his multiple basin quantitative technic for evaluating the bacteriologic status of the skin of the hands. In this important study he elaborated standard curves for the soap and water scrub (±50 per cent reduction in bacteria for each six minutes of scrubbing), demonstrated the merit of 70 per cent (by weight) ethyl alcohol (±50 per cent reduction for each minute of immersion), noted the relative inefficiency of other commonly used agents, and measured the rate of increase in skin organisms under rubber gloves (the number approximately doubling every forty minutes). Thus, the beginnings of order were spread over the chaos on the canvas of skin cleansing. This method has become standard for the evaluation of degerminating agents.

It is possible that the usual scrubbing ritual has merits as a teaching technic and a self-imposed discipline which exceed its value as a cleansing maneuver. The honest adherence to prolonged scrubbing by the clock emphasizes to the student the significance of asepsis and serves as a constant reminder to the surgeon of the importance of preserving one of the basic corner stones of his technic. On the other hand, in spite of this function as watch dog of the surgical conscience, it would seem that a scrub routine which possesses increased efficiency in degermation both in extent and uniformity of result and at the same time effects a saving in time would have real merit both to the patient and to the doctor.

Within recent years new antiseptic agents have been developed which appear to be highly bactericidal in low concentration, are relatively non-toxic and possess desirable detergent action. Domagk[11] was the first to call attention to this antiseptic quality in a quaternary amine (alkyl dimethyl benzyl ammonium chloride). Many such substances exist which have been collectively termed the quaternary ammonium compounds. They act antibacterially as cationic detergents and represent a well defined group of agents whose action on bacteria is distinct from dyes,

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oxidizing agents and the heavy metal compounds. Because of their hydrophilic-hydrophobic structure they exhibit remarkable surface activity[1,11,12,41,47] making them good wetting and detergent agents; and although high surface tension depression appears related to antiseptic action,[41] it does not parallel bactericidal activity within a given series.[44]

Specific antibacterial activity has been found in high dilutions with several types of these cationic detergents, especially those quaternary ammonium compounds containing aromatic or alkyl-phenyl radicals, aliphatic radicals or heterocyclic nitrogen.[35] The relation between chemical structure and bactericidal activity has been investigated[44,49] and the most effective length of the long chain was found to be lauryl, myristyl or cetyl. Octyl substituted phenyl compounds seemed most effective with the diisobutyl grouping. Clear understanding of the relationship between structure and activity has not yet been achieved.[25,54]

Two separate actions appear to be involved in this bactericidal effect, for there is apparently both inhibition of metabolism[2,25,36] and cytolytic damage.[2,25,26,47] This action is thought to be due to the combination of the cation of the antiseptic with an essential anion in the bacterium forming a non-ionized complex.[1,25,41] It has been suggested these vital anions may be the nucleic acids.[3] The speed of this action may be enhanced because of the hydrophilic and lipophilic propreties which promote high tissue penetrating capacity. Dilutions as low as 1 gamma per cc. (one part in a million) may be bacteriostatic against viable organisms; much higher concentrations are required for bactericidal action and spores.[24]

It is to be noted that soaps fall into the group of anionic detergents since in them the alkyl radicals carry a negative charge. Soaps are but poor bacterial inhibitors[6,15,51,55] and are active largely against the gram-positive organisms only.[3] *Moreover, it is extremely important to realize that soaps inactivate the cationic detergents.*[14,37]

Industrially, the quaternary ammonium compounds have a variety of uses depending on their properties as a wetting agent. In bacterial control they are used extensively for the cleansing of equipment in restaurants, dairies, lavatories, etc. Some hesitancy has been shown by public health officers in approving and endorsing their use for the purpose of bacterial control.[34,45] Because of their known tendency to cause agglutination of organisms, serious criticism of the standard F.D.A. method of evaluating their bactericidal activity has been raised.[34] This is a very important technical consideration and throws considerable doubt on the validity of all *in vitro* studies of the quaternary ammonium compounds. Its relation to this study is elaborated later in this report.

Several of these compounds have already been the subject of investigation in terms of their potential clinical use. A mixture of quaternary ammonium compounds containing alkyl-phenyl radicals (alkyl (C_8-C_{18}) dimethyl benzyl ammonium chloride)* was the first compound to receive study as a disinfectant.[11] Its disinfecting quality was found to be great even in very dilute solutions.[4,13,48,56,59] Its action has been ascribed to the formation of an invisible film which is resistant to mechanical trauma and which retains the bacteria beneath it.[37] This "film" was found to be destroyed by anionic detergents or by fifteen to thirty seconds in running tap water. Since the zephiran in this experiment was a 1 per cent aqueous solution and since it has been shown that zephiran in concentrations as low as a few parts per million are bacteriostatic, it is probable that enough of the compound remained on the hands to continue to act either as a bactericide or was washed off in the collecting basin and acted bacteriostatically. Although the concept of a mechanical "film" is open to question, this problem is a serious one in evaluating results obtained

* Zephiran.

by the Price technic. Little doubt can remain that zephiran is a strongly bactericidal agent against a broad spectrum of bacteria.[20,53] It has been tested as a hand degerming agent[18,33] in dilute aqueous solutions and alcoholic solutions, with indeterminant results, possibly because of pitfalls in the methods used.

Another compound of the zephiran group (para-tertiary octylphenoxy ethoxy ethyl dimethyl benzylammonium chloride*) was chosen for study after a preliminary screening of over thirty compounds.[44] Using the Shippen modification of the F.D.A. *in vitro* test,[50] a broad range of bactericidal action was found including common pathogenic fungi.[28] It was found to be a more effective skin disinfectant than other commonly used agents although no better than iodine.[10] This study, although cleverly performed, is open to question because in the use of contact agar plates against the variously prepared skin surfaces adequate amounts of the phemerol to be bacteriostatic may have been transferred to the plates. Moreover, the skin areas were first washed with soap, water and alcohol, and enough soap may have remained on the skin to neutralize the phemerol partially. Using a new and ingenious *in vivo* test, phemerol in 1:500 tincture was found to be more effective than other agents but less effective than 2 per cent iodine[38] against known strains of pneumococcus and streptococcus. It is unfortunate that the agent was not tested in greater strengths. The method has the disadvantage that action against only "transient" bacteria is studied. The cytologic toxicity of phemerol in comparable bactericidal units was found to be low and compared favorably with other agents although in this test penicillin was superior.[22] This low toxicity was confirmed, its use as a skin disinfectant was studied by the swab technic with favorable results and its effect in dilute solutions in open contaminated wounds was observed.[26] The compound is effective against Eschericia histolytica and Trichomonas vaginalis.[29,52] The use of phemerol in conjunction with promanide has been suggested for tuberculous empyema.[27] This combining of a wetting agent with a known disinfectant to enhance its action, as originally suggested by Petroff,[40] has opened a field which is filled with conflicting data[9,17,39] but which may hold promise for the future. Since the cationic detergents have intrinsic bactericidal action, their use with other agents may prove synergistic.

Cetylpyridinium,* a quaternary ammonium compound containing heterocyclic nitrogen with a single alkyl radical, has also been rather extensively studied and was found to be bactericidal in low concentrations.[7,8,19,46,49] It has a low toxicity to tissue cells.[57,58] Its action as a skin disinfectant was tested[21,23,30,31] but the method (swab) in all of these studies is open to question.

Cetyltrimethyl ammonium bromide,† a quaternary ammonium compound containing only alkyl radicals, has been shown to be more effective in low concentration than soap, alcohol or tincture of iodine.[1] Its use has been advocated for impetigo[16] and for skin disinfection.[5,60]

In summary of this literature we may say that certain quaternary ammonium compounds have been found to be highly bactericidal in high dilutions *in vitro*. They possess in addition wetting, detergent, emulsifying and emollient properties. Their use clinically as skin degerming agents has been investigated but many of the procedures used in these investigations have not been, in our opinion, sufficiently critical. Moreover, the strength of the solutions tested clinically does not appear to be optimal. It is the purpose of this communication, therefore, to ascertain if these agents are effective as skin degerming agents for use by the surgeon for preoperative cleansing of the hands and, if so, by what method and in what concentrations.

* Phemerol.

* Ceepryn.
† Cetab.

PRELIMINARY STUDIES

As has been stated, sufficient evidence exists that the majority of quaternary ammonium compounds exert bactericidal action. Two factors appear to be operative: one, bacterial inhibition and, second, an actual killing of organisms. In a separate study[24] the bactericidal and bacteriostatic effects of these compounds has been confirmed with respect to certain pathogenic bacteria living in artificial environments. It has been noted in this laboratory that concentrations needed for lethal action were not necessarily those required for inhibition of growth and that different concentrations were required to induce such effects in different organisms. These preliminary studies were necessary for determining the range of concentration of the quaternary ammonium compound to be used in the surgical scrub.

Another consideration was the effect of the quaternary ammonium compound on bacterial spores since these often play a rôle in the infectious process. It was observed that a higher concentration was required to inhibit or kill spores. In some instances the spores were inhibited for a period of weeks and then spontaneously became proliferating bacteria. To inhibit such a process concentrations of 2 per cent or more of the specific quaternary agent had to be used.

One of the disturbing factors in the evaluation of quaternary ammonium compounds is the fact that at certain concentrations or over a period of contact this agent tends to agglutinate organisms. Thus, a certain concentration may take several hours to accomplish this phenomenon. This effect may introduce a source of error in interpretive colony counts.[34] If, for instance, several thousand viable organisms are agglutinated, they would yield only one colony in the culture medium. Thus, the colonies on a plate count might represent not the growth from a few organisms as isolated units but from many agglutinated bodies.

Agglutination may be regarded as a naturally occurring surface tension effect of the agent on the organisms and usually occurs when the two are brought together. In thirty minutes different concentrations of hyamine* induced varying degrees of agglutination against Escherichia coli. (Fig. 1.)

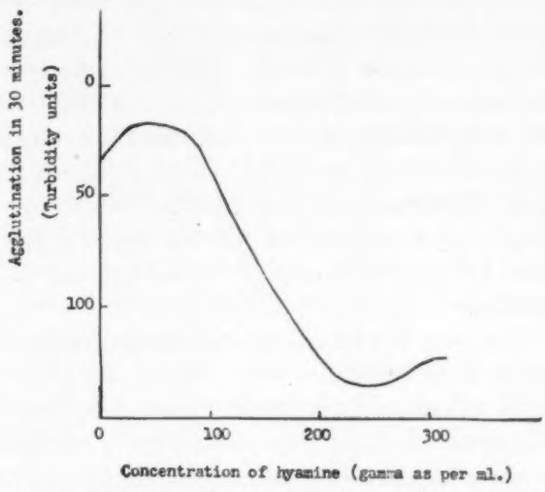

Fig. 1. Relation of concentration of hyamine to degree of agglutination at thirty minutes.

Since the bacterial counts obtained from the surgical scrub were determined by the plate counting method, a source of error might be anticipated if these colonies were the result of many organisms agglutinated in masses. The same experiment noted above was performed using 3 per cent hyamine. In order to obviate any extrinsic cause for turbidity the study on 3 per cent hyamine was carried out in series using direct microscopic observation. At this concentration no agglutination was observed against Escherichia coli in forty minutes. Following this period agglutination occurs in varying degrees. Therefore, on the basis of this observation it would seem likely that the colonies obtained following the scrub were not the result of agglutinated masses of organisms. Since the bacterial flora of the surface of the hands is mixed, the hands were washed

* Hyamine 1622 (Rohm and Haas), p-diisobutyl phenoxy-ethoxy ethyl dimethyl ammonium chloride, also called Teramine (West Disinfecting Co.), and apparently the same as phemerol although the chemical formulas are stated differently.

both with water and the 3 per cent quaternary ammonium compound solution and the organisms observed for a period of sixty minutes. Thus, the mixed flora did not agglutinate during this period with the concentration of the agent used.

We believe it is safe to say, therefore, that in all of the experiments in this study done without gloves, agglutination of organisms could have played no rôle in the results since the time of contact (never more than five minutes) was too short for this effect to have occurred. Even in the longer glove experiments, we believe that this factor had negligible effect on the results.

Because of the use of quaternary ammonium compounds in concentrations higher than those which have been previously recommended, it was considered desirable to investigate the problem of toxicity. The oral administration of hyamine to mice and dogs does not produce particularly significant toxic manifestations (Rohm and Haas report) and LD_{50} is in the neighborhood of 500 mg. per kg. On the other hand, the mouse does not tolerate intraperitoneal or intravenous administration of this agent. Death occurs when it is given intravenously at approximately 1 mg. per kg. and intraperitoneally at approximately 3 mg. per kg.

The intravenous tolerance of the dog is somewhat higher. In one dog in which an aqueous solution of 5 per cent hyamine was used, 7 mg. per kg. administered intravenously was tolerated without symptoms. In another animal 15 mg. per kg. was tolerated although symptoms of ataxia and prostration were observed. The animal, however, recovered. In a third animal a dose of 27 mg. per kg. produced coma and death. Thus, the dose tolerated intravenously by the dog would appear to be between 7 and 15 mg. per kg.

Intraperitoneally the dog tolerated 100 mg. per kg. although it suffered from vomiting, malaise and blood-stained diarrhea; recovery was spontaneous. It would appear to be inconceivable that doses of this amount could be carried by the gloves of the surgeon into the abdominal cavity of a patient. However, it is worth while noting that it is undesirable to spill 3 per cent hyamine solution into the free peritoneal cavity.

There is apparently no significant absorption from granulating wounds. In two animals constant wet soaks of 3 per cent aqueous hyamine were kept over a granulating area 7.5 cm. square for a period of five days. No toxicity was noted and there was no inhibition of the healing. The granulating area remained quite clean.

It would seem, therefore, that although in very high doses hyamine was toxic when given intravenously or when poured into the free peritoneal cavity, there is adequate margin of safety in its every day use in the operating room. There appears to be no particular danger of abnormal absorption through granulating wounds.

EXPERIMENTAL METHOD

A modification of the method of Price[42] was used. The subjects were third and fourth year medical students, approximately sixty individuals participating one or more times in the experiments. There was, of course, considerable individual variation in the manner in which these subjects executed the scrubs. We consider this important in the evaluation of the results of any such experiment; because if consistent results can be obtained under these conditions, it speaks highly for the effectiveness of the agents used irrespective of the mechanical efficiency of the user.

All equipment, i.e., pipettes, petri dishes, brushes, basins, towels, gloves, etc., were sterilized by autoclaving prior to the experiment. The experiments were all performed in the same operating room under relatively similar conditions. Air contamination of the basins was checked at first and found to be a negligible factor. Thereafter no air control basins were used.

The initial bacterial flora on the hands was obtained by a specified type of brush scrub extending up to the wrists for exactly

one minute in a basin containing 1 L. of sterile water. The second step was to scrub the hands for a prescribed time in the solutions to be tested. In the experiments on soap and in the last series of tests of the quaternary ammonium compound the scrubs were performed over a sink using running water, obtaining the degerming agent from a standard soap dispenser. If a soak was to be used, it was entered immediately on conclusion of the scrub. The hands were then dried on a sterile towel and evaluation of the remaining bacterial flora was obtained by scrubbing for exactly one minute in each of a series of basins containing 1 L. of sterile water. A new sterile brush was used for each basin.

Whenever the quaternary ammonium salt was being used, and as a control in some of the soap experiments, the subject preceded the final series of basins by a one minute scrub in a basin containing 1 L. of 0.5 per cent Savol.* This step is extremely important because the soap neutralizes the action of any of the quaternary which may remain on the hands so that none will be carried into the evaluation basins. If this is allowed to happen, even minute amounts will act bacteriostatically and the bacterial counts will be erroneous (too low). Moreover, if as has been suggested[37] a film has been formed by the quaternary, this soap scrub will destroy the film and allow the true count to be obtained.

When gloves were to be used, the subject entered a sterile gown after his scrub and then put on the gloves, using sterile technic, whether wet or dry. He then pursued his usual activities around the hospital, no attempt being made to keep the outside of the gloves sterile. He returned for terminal bacterial counts at the end of a two-hour period.

No skin reactions were observed by any of the subjects participating in this experiment. However, when the quaternary was used under rubber gloves, many individuals volunteered amazement at the lack of hand sweating which they experienced during the two-hour period the gloves were worn. It was frequently observed that the hands appeared quite dry when the terminal counts were made in spite of active use of the hands during this period.

The bacterial counts were obtained in the following fashion: Three separate 1 cc. samples of the water were obtained after vigorous stirring with a sterile pipette immediately following the use of a rinsing basin. Each sample was mixed with 10 cc. of nutrient agar and then poured into a petri dish. Colony counts were obtained after forty-eight hours' incubation at 37°C. Thus, each subject was checked by four separate basins and each basin by three separate counts.

The final count was obtained by finding the average of the three samples taken from each basin; this multiplied by 1,000 is the count for the basin: the average of the three basins, taken after the scrub, was used as the post-scrub count. The experimental results are expressed both in actual bacterial count and as percentage reduction in bacteria with the standard deviation of per cent.

It must be noted that whenever per cent reduction or the actual data reveal a value indicating a decrease in bacterial numbers, *the figure always indicates the amount of bacteria which can be recovered from the hands and nothing more.* Although the number of organisms which can be removed would appear to be a function of the number present on the skin, the figures in no direct way express the actual number of bacteria on the skin surfaces nor do they indicate, in substance, the number of organisms destroyed. *What the figures mean are the number of viable organisms which can be removed from the skin surface in a stated period of time.* If an agent reduces the number of organisms which can be obtained from the skin, it is assumed that this agent has played a rôle in reducing the number of organisms present, providing that a film is not the protective mechanism. Regardless of the efforts by others[42] to calculate the number of bacteria present

* A commercial anionic detergent.

on the skin, there is no method which directly corroborates a calculated value. For practical purposes the agents used reduce the number of organisms presumably capable of infecting another surface and hence merit their use in the surgical scrub to decrease the incidence of contamination. Ideally, therefore, if no bacteria will be obtained from a skin surface, even though some were present in the hair follicles, glands and interstices, the probability of contamination at that given moment would be zero. As the per cent reduction of removable bacteria approaches 100, it is presumed the general possibility of infection approaches zero.

TABLE I

TYPICAL SAMPLE COUNTS SHOWING THE EFFECT OF SAVOL IN COUNTERACTING THE BACTERIOSTATIC EFFECT OF RESIDUAL QUATERNARY AMMONIUM COMPOUNDS*

Subject	Initial Count	Agent Used	Savol	1st Basin	2nd Basin	3rd Basin	4th Basin	5th Basin	6th Basin
A	1,450	Hyamine 3% for 2 minutes	No	.7	3	5	5	4	5
B	720	Same	Yes	6	5.7	12	8	5	

* In this table, and in *all* other Tables, any otherwise unqualified figure represents the number of organisms in thousands; thus 1,450 means 1,450,000 organisms.

TABLE II

CONSISTENCY OF SAMPLING OBTAINED BY METHOD

Subject	Initial Basin	Scrub Agent and Time	1st Basin	2nd Basin	3rd Basin	Post-scrub Figure Used for Computations (Average Mean)
A	1st dish—5,880 2nd dish—6,120 3rd dish—6,420 Mean—6,140	Soap scrub 7 min., 70% alcohol 1 min.	1st dish—450 2nd dish—420 3rd dish—360 Mean—410	1st dish—480 2nd dish—420 3rd dish—330 Mean—410	1st dish—174 2nd dish—150 3rd dish—180 Mean—168	329
B	1st dish—9,720 2nd dish—8,620 3rd dish—8,880 Mean—9,040	Hyamine 3% 4 min., 70% alcohol 1 min., Savol .5% 1 min.	1st dish—118 2nd dish— 84 3rd dish— 90 Mean—94	1st dish—11 2nd dish—28 3rd dish— 8 Mean—17	1st dish—46 2nd dish—69 3rd dish—83 Mean—66	59

STUDIES EVALUATING THE METHOD

In the first place, a rather surprising uniformity was found in the three samples taken from each basin. This was particularly true when the count was high. In very low counts there was, as would be expected, a greater percentage variation. We believe that the basin counts reflect a high degree of accuracy.

The variation between basins is somewhat greater. However, no pattern of variation appeared to exist (for example, a consistant increase or decrease in counts along the series of basins). It appeared that the average of three basins, therefore, gives a fair approximation of the actual organisms removable by a one-minute brush scrub in water, i.e., the basic unit of the method. Moreover, the method serves as a check against any bacteriostatic effect of residual degerming agent, for in this case there is a steady rise in the counts through the series of basins.

Table I is an example of this effect, and shows the necessity of the use of a soap (Savol) scrub following application of a quaternary ammonium compound before counts are made. In this case the series of basins used was enlarged to six in order to observe how far along the series bacteriostatic effect extended if Savol is not used. It can be seen that the counts do not stabilize until the fourth basin in this case (A) whereas they are relatively stable from the beginning when Savol is used (B).

It is recognized that some of the data presented in this paper lack comparative statistical significance when subjected to analysis. This is because of the small size of the samples which in most series was only five individuals. In order to determine the validity of some of the conclusions we submitted the data to statistical analysis. Where statistical significance is attached to the evidence, this is indicated in the body of the report.* The Tables give the data in both absolute numbers of bacteria and in per cent reduction. The mean per cent reduction for any series is presented together with the standard deviation.

As an example of the degree of uniformity in the data obtained by this method, two typical protocols are presented in Table II. Many of the protocols show even less variation than these samples.

As a basis for comparison, the effectiveness of the commonly employed surgical scrub with soap† and alcohol was first studied. Table III gives these results, which are essentially similar to those obtained by Price for soap alone, but indicate better performance for soap scrub followed by alcohol rinse than he observed.

TABLE III

THE EFFECT OF SOAP AND SOAP AND ALCOHOL ON THE BACTERIAL FLORA OF THE HANDS

Subject	Agent Used	Pre-scrub-Count	Post-scrub Count	Reduction in Removable Organisms Per Cent	Mean Reduction, Per Cent, and Standard Deviation
1	Soap scrub for 7 min.	2,440	239	90.2	54.4 ± 21.5
2		6,600	1,500	77	
3		1,320	848	35.8	
4		5,400	3,270	39.5	
5		1,800	1,300	31.7	
6		2,940	873	70.7	
7		6,600	3,173	52	
8		2,100	853	59.4	
9		6,240	4,134	33.8	
1	Soap scrub for 7 min., 70% alcohol rinse for 1 min.	2,613	29.7	98.9	91.8 ± 6.1
2		19,280	2,645	86.4	
3		1,170	182	84.5	
4		6,140	329	94.7	
5		704	40	94.4	
1	Soap scrub for 7 min., 70% alcohol rinse 1 min. .5% Savol scrub 1 min.	2,000	427	79.7	90.7 ± 8.2
2		1,394	29	97.9	
3		1,290	98	92.4	
4		5,950	94	98.5	
5		3,180	482	84.8	

It would appear from Table III that surgical scrubs using soap alone or soap and alcohol present a rather high standard deviation. This would suggest that the results of these technics are quite variable and in a considerable percentage of instances the scrub, therefore, is ineffective.

When the hands are scrubbed in a basin containing 3 per cent solution of hyamine, the uniformity in reduction of bacteria is considerably improved; Table IV gives these results.

It can be seen from Table IV that 3 per cent aqueous hyamine appears to be effective in reducing the bacterial flora of the hands. It is recognized that the Table does not demonstrate a statistically significant difference between a one-minute and a four-minute scrub. We may say, however, that a one- to four-minute scrub in a basin containing a 3 per cent hyamine is both an

* To evaluate the statistical significance of a difference between two mean values, a critical ratio was determined using the following formula:

$$\text{C. R. (Critical Ratio)} = \frac{\text{Difference in means}}{\pm\sqrt{\frac{(\text{S.D.}_1)^2}{N_1} + \frac{(\text{S.D.}_2)^2}{N_2}}}$$

If C. R. is less than 2, the different is *not significant* since it might occur by chance more often than 1 time in 20.

If C. R. is between 2 and 3, the difference *is significant* since the result might occur by chance less often than one time in 20.

If C. R. is over 3, the difference is *highly significant* since the result might occur by chance less often than one time in 370.

† A commercial product known as Septisol.

efficient and a relatively uniform procedure for the surgical preparation of the hands, that it is significantly better than a soap scrub and that efficiency increases with increasing time of contact.

hyamine when utilized in this fashion. The regular operating room soap dispensers were thoroughly cleaned and filled with hyamine. The subjects scrubbed with a brush in running water exactly as if they had been using the customary anionic soap. Table v gives the data on this experiment which appear to indicate that using hyamine from the dispenser is approximately as effective as scrubbing in hyamine in a basin.

TABLE IV

EFFECT OF SCRUBBING IN A BASIN OF 3 PER CENT AQUEOUS HYAMINE ON THE BACTERIAL FLORA OF THE HANDS—VARIATION BY TIME OF CONTACT

Subject	Agent	Savol	Pre-scrub Count	Post-scrub Count	Reduction (Per Cent)	Mean Reduction, Per Cent, and Standard Deviation
1	3% aqueous hyamine for 1 min.	1 min. in .5% Savol	1,040	3.4	99.7	
2			930	18	98.1	
3			360	2	99.4	95.3 ± 8.55
4			9,070	59	99.3	
5			334	70	80.0	
6	3% aqueous hyamine for 2 min.	1 min. in .5% Savol	2,680	3.4	99.0	
7			660	19	97.2	
8			274	15.6	94.3	96.7 ± 2.18
9			850	45	94.7	
10			820	11.8	98.6	
11	3% aqueous hyamine for 3 min.	1 min. in .5% Savol	2,040	69	96.7	
12			3,480	11.7	99.7	
13			2,830	55.8	98.1	97.7 ± 1.24
14			2,450	76.3	96.9	
15			2,460	72	97.1	
16	3% aqueous hyamine for 4 min.	1 min. in .5% Savol	950	8.9	99.1	
17			2,160	1.7	99.9	
18			630	6.1	99.1	99.1 ± 0.86
19			1,910	6	99.7	
20			980	23.3	97.7	

Since in most hospitals any fluid soapy solution used for scrubbing the hands is delivered by a soap dispenser, we wished to evaluate the effectiveness of 3 per cent

TABLE V

EFFECT OF SCRUBBING IN RUNNING WATER USING 3 PER CENT AQUEOUS HYAMINE FROM A SOAP DISPENSER

Subject	Agent	Pre-scrub Count	Post-scrub Count	Reduction Per Cent	Mean Reduction, Per Cent, and Standard Deviation
1	Scrub in running water for 4 min. using 3% aqueous hyamine from dispenser; dry with sterile towel; 1 min. ½ % Savol rinse	9,647	242	97.5	
2		3,293	50	98.5	
3		440	65	98.6	97.5 ± 1.82
4		1,500	6	99.6	
5		308	21	93.2	

Table v gives the data on this experiment which appear to indicate that using hyamine from the dispenser is approximately as effective as scrubbing in hyamine in a basin.

From the data obtained to this point it appeared that 3 per cent hyamine was a practical and effective agent to use for the preparation of the surgeon's hands. We wished now to establish the optimum technic which would be uniformly acceptable for use in operating rooms generally. Does hyamine exert a lasting bacteriostatic effect when rubber gloves are worn? Will an alcohol rinse enhance or diminish its value? What is to be expected if wet or dry glove technic is used? The first step was to compare the results of a simple one-

minute soak in 3 per cent aqueous hyamine with a similar immersion in 70 per cent (by weight) ethyl alcohol. Table VI gives this comparison. It appears that both solutions have a relatively high effectiveness in per cent reduction, but that the hyamine seems to result in a lower mean post-soak count and is considerably more consistent. In this experiment we found 70 per cent ethyl alcohol to be more effective than was reported by Price.

The relative merits of a hyamine scrub, a hyamine scrub plus a one-minute alcohol soak, a hyamine scrub plus a one-minute hyamine soak, all followed by dry gloves worn for two hours, and a hyamine scrub

TABLE VI

COMPARISON OF THE BACTERICIDAL EFFECT OF A ONE MINUTE SOAK IN 70 PER CENT ALCOHOL AND IN 3 PER CENT AQUEOUS HYAMINE

Subject	Agent	Pre-soak Count	Post-soak Count	Reduction (Per Cent)	Mean Pre-soak Count	Mean Post-soak Count	Mean Reduction, Per Cent, and Standard Deviation
1	One min. soak in 70% ethyl alcohol; dry with sterile towel; 1 min. ½% Savol	8,414	2,604	96.9			
2		486	138	71.7			
3		450	6	98.7	3,599	443.8	85.5 ± 12.3
4		3,200	378	87.6			
5		5,448	1,433	74.9			
6	One min. soak in 3% aqueous hyamine; dry with sterile towel; 1 min. ½% Savol	1,370	131	90.5			
7		404	44	89.1			
8		2,308	238	89.7	1,170	128.6	89.4 ± 1.75
9		1,660	220	86.7			
10		108	10	91.2			

TABLE VII

EFFECT OF 3 PER CENT HYAMINE SCRUB AFTER TWO HOURS WEARING RUBBER GLOVES

Subject	Technic	Pre-scrub Count	Post-scrub Count	Reduction (Per Cent)	Mean Pre-scrub Count	Mean Post-scrub Count	Mean Reduction, Per Cent, and Standard Deviation
1	Scrub in 3% aqueous hyamine for 5 min., dry gloves for 2 hr.	559	51	90.8			
2		2,910	87	96.4			
3		680	17	97.7	1,189	40.2	95.9 ± 2.0
4		666	22	96.8			
5		1,130	24	97.9			
6	Scrub in 3% aqueous hyamine for 4 min., 70% alcohol soak for 1 min., dry gloves for 2 hr.	3,600	70	98.1			
7		3,480	107	97			
8		5,620	59	99	2,819	64.4	96.3 ± 2.4
9		432	28	93.7			
10		962	58	94			
11	Scrub in 3% aqueous hyamine for 4 min., 3% aqueous hyamine soak for 1 min., dry gloves for 2 hr.	890	3	99.7			
12		11,600	12	99.9			
13		7,120	159	97.8	4,411	47.0	98.3 ± 1.7
14		713	32	95.6			
15		1,724	29	98.4			
16	Scrub in 3% aqueous hyamine for 5 min., wet glove technic worn 2 hr.	992	10	99			
17		3,900	5	99.9	6,863	10.8	99.6 ± 0.38
18		17,780	25	99.8			
19		4,780	3	99.9			

followed by two hours of gloves using wet glove technic are demonstrated in Table VII. All of these procedures appear to be highly effective and consistent.

The differences in the results in Table VII statistically show in a very significant compound throughout leading to dry gloves. (Although the best method is the wet glove technic, it was thought that few surgeons would wish to adapt a technic which is unfamiliar and uncomfortable to the majority.) Accordingly, a larger series

TABLE VIII

EFFECT OF SOAP AND WATER SCRUB WITH ALCOHOL SOAK AFTER TWO HOURS WITH GLOVES

Subject	Technic	Pre-scrub Count	Post-scrub Count	Reduction (Per Cent)	Mean Pre-scrub Count	Mean Post-scrub Count	Mean Reduction, Per Cent, and Standard Deviation
1		8,400	146	98.3			
2		5,000	372	92.6			
3		2,170	158	94.2			
4	7 min. scrub soap and water;	4,880	76	98.5			
5	1 min. soak 99% isopropyl	5,170	206	96.0			
6	alcohol; dry gloves ½%	3,080	163	94.7			
7	Savol	310	50	85.3			
8		966	102	89.5			
9		4,380	37	98.2			
10		3,000	88	97.4	2,765	98.2	96.4 ± 3.7
11		4,240	201	95.3			
12		1,420	26	98.2			
13		557	42	92.3			
14		2,360	39	98.4			
15		1,370	29	97.9			
16		1,580	47	97.0			
17		2,317	25	98.3			
18		2,310	42	98.3			
19		356	6	98.3			
20		1,440	110	92.4			

fashion (C.R. = 4) that the most effective method is the use of the wet glove technic. However, in most hospitals in the United States dry glove technic is preferred. Most surgeons like an alcohol soak following their scrub because in addition to its bactericidal activity it makes the hands very easy to dry before donning the powdered glove. From the data here presented the use of the quaternary ammonium compound followed by an alcohol rinse would appear to be quite satisfactory. However, drying the hands after soaking them in the 3 per cent aqueous hyamine solution is not annoying or difficult; and since the latter seems to have a slightly better effect, we chose to evaluate more thoroughly the technic of using the quaternary ammonium was observed and this was compared to an equal series using the standard current surgical scrub with soap and water followed by alcohol. Tables VIII and IX give these results.

The soap and water alcohol scrub proved to be more effective than we had anticipated (96.4 ± 3.7 per cent reduction). The hyamine combination, however, was more effective (98.9 ± 1.9 per cent reduction) and more consistent. The *lowest* result with hyamine was 94.3 per cent while the *lowest* with the standard scrub was 84.3 per cent. Moreover, although the average prescrub count with hyamine was slightly higher, the average post-scrub count was less than half that resulting from the standard scrub. In the last analysis the number of available

removable organisms is the best criteria to evaluate the potentialities for contamination. It would appear reasonable to say, therefore, that a four-minute scrub with 3 per cent aqueous hyamine followed by a one-minute soak in the same agent gives a greater, more consistent and more complete reduction in removable bacteria on the hands after two hours using dry glove technic than the standard soap, water and alcohol routine. The difference is statistically significant (C.R. = 2.4). This method had the additional advantage of reducing the time necessary for the surgical scrub to a total of five minutes.

TABLE IX

EFFECT OF HYAMINE SCRUB AND SOAK AFTER TWO HOURS WITH GLOVES

Subject	Technic	Pre-scrub Count	Post-scrub Count	Reduction (Per Cent)	Mean Pre-scrub Count	Mean Post-scrub Count	Mean Reduction, Per Cent, and Standard Deviation
1		890	3	99.7			
2		11,600	12	99.9			
3		7,120	159	97.8			
4	4 min. scrub 3% aqueous hyamine from dispenser; plus	713	32	95.5			
5	1 min. soak 3% aqueous hyamine; dry gloves for 2 hr.	1,724	29	98.4			
6	½% Savol	724	13	98.3			
7		2,980	6	99.8			
8		2,294	34	98.6			
9		717	23	96.8			
10		510	11	97.9	3,075	44.6	98.6 ± 1.9
11		1,470	84	94.3			
12		950	8	99.2			
13		3,340	40	98.8			
14		120	9	93.4			
15		1,970	4	99.8			
16		1,970	46	97.7			
17		5,080	104	97.6			
18		3,012	104	96.6			
19		4,080	81	98.0			
20		10,260	74	99.4			

SUMMARY

1. The quaternary ammonium compounds, as a group, are detergent and bactericidal in dilute aqueous solutions and are superior in both actions to anionic soaps. They offer, therefore, potential advantages for use in the surgical scrub.

2. A study of the effectiveness of one commonly used such compound (hyamine) as a degerming agent for the surgical preparation of hands is presented.

3. The use of an aqueous solution stronger (3 per cent) than heretofore commonly employed is recommended. This is a foaming bactericidal detergent solution whose physical action closely simulates the common anionic soaps.

4. This solution is much more effective in reducing the bacterial flora of the hands than the standard soap scrub followed by an alcohol rinse.

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COLECTOMY*

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COLECTOMY as a means of treating a diseased colon is a relatively new procedure for it is only during the past decade that modern surgical methods have advanced enough to make the procedure safe. Although surgery of the rectum dates back to the time of Hippocrates, Celsus and Paul of Aegena[14] (who described treatment of fissures, fistulas, hemorrhoids, etc.), surgery of the colon was held in abeyance until after the dawn of the Listerian era. Morgagni, early in the eighteenth century, proposed operative treatment of cancer of the rectum but it was not until 1739 that Faget first attempted it.

Colostomy had been reported to be used by veterinarians as early as 400 B.C. In 1776 it was used by Pillore in treatment of cancer of the rectum. In 1823 Reybard resected the sigmoid flexure for carcinoma. By 1880 only ten resections had been reported and only three of these were successful. An important advance in colon surgery was the extraperitonealizing of a segment of bowel, the procedure now commonly called Mikulicz. It was reported by Block of Copenhagen in 1891. This procedure made it possible to prevent postoperative peritonitis which had prevented advances in colon surgery.

During the past ten years, because of better understanding of methods to prevent shock, improved anesthesia, chemotherapy, blood and plasma transfusions, the mortality rate in colon surgery has been lowered to the point where such surgery is now safe. Swinton and Warren[15] reported experiences at the Lahey Clinic in which the resectability rate for carcinoma of the colon and rectum had increased from 50 per cent in 1928 to 89.9 per cent in 1938, with a lowering of mortality from 36 per cent in 1928, to 10 per cent in 1938 and 3.8 per cent in the period from 1941 to 1946.

Throughout the centuries the principal indication for colon surgery was to eradicate cancer or to relieve the effects of cancer, i.e., palliation. At the present time cancer is still the most frequent and most important disease for which surgery of the colon is used. Recently, however, because of the greater safety margin, colon surgery has been used in more benign lesions.

This paper presents three cases which demonstrate three diseases in which colectomy was successfully used to eradicate the disease. They are: (1) Hirschsprung's disease; (2) congenital polyposis of the colon and (3) chronic ulcerative colitis.

HIRSCHSPRUNG'S DISEASE

Varying degrees of dilatation of the colon associated with obstruction are frequently seen. True congenital megacolon, or Hirschsprung's Disease (first described fifty years ago by Hirschsprung), is uncommon. The etiology of this congenital disease is unknown. Disturbances of the autonomic nervous system are believed a factor (as suggested by temporary benefits of sympathectomy). The origin seems to be in the intrinsic innervation of the bowel wall (plexus of Auerbach) and not in the sympathetic nervous system itself. Symptoms usually begin shortly after birth, but by the time treatment is undertaken secondary pathologic changes (hypertrophy and fibrosis of the bowel wall) have taken place. The picture is then not one of a normal bowel with marked dilatation but a hypertrophied fibrosed tube. This tube loses its contractibility and becomes greatly distended unless manually emptied from below.

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These patients usually go for weeks or months without a bowel movement, but with repeated high colonic irrigations are able to empty the bowel. The continued trauma and irritations usually lead to stricture formation and to varying degrees of intestinal obstruction. One-third of the cases involve the sigmoid only[9] while 15 per cent involve the entire colon. The rectum is rarely involved. Most of these patients become frequent visitors to local clinics for emergency treatment of obstruction.

Treatment in the past has been by medical management, i.e., having the patients irrigate the colon and whenever the mass obstructs the colon to give the patient an anesthetic and manually remove the feces from the rectum. Under this regimen it was noted that after spinal anesthesia these patients occasionally had a large bowel movement. This was in accord with the theory as to the etiology of the disease, i.e., imbalances of autonomic nervous system, and lead to the practice of sympathectomy. DeTakats[9] (quoted by Grimson, et al.) believes that some megacolons have thin atrophic walls instead of hypertrophied walls, and that if spinal anesthesia fails to give beneficial results sympathectomy would be of no value. He advises a left lumbar sympathectomy.

Various new sympathecticometic drugs, methyl bromide, a parasympathetic stimulant, and syntropan, an atropine-like drug, recently have been added to medical means of treatment. It is difficult to visualize, however, how any drug or a sympathectomy could alter the fundamental pathologic condition in the gut wall or make a fibrosed gut wall contract. In the past it was recognized that such management was not satisfactory, but because of the high mortality rate associated with colectomy no other therapy was available. Sympathectomy seemed to give temporary beneficial results.

With modern improvements in operative technic, anesthesia and postoperative care, the morbidity and mortality rate for colon surgery has been lowered to where it is now lower than the results of medical management. In reviewing the literature[9] Grimson, Vandergriff and Dratz found an average mortality from medical management of 58 per cent (19 to 79 per cent), for the more severe forms of megacolon. The literature contains numerous references of megacolon treated by colectomy.[4,6,9,12,18] Since the rectum rarely is involved, it is possible to connect the terminal ileum (or proximal colon to the sigmoid), thus retaining the rectal sphincter such as the following case demonstrates.

CASE REPORTS

Case 1. E. O., a nineteen year old white male born in Brooklyn, was admitted to the hospital December 18, 1944, and was discharged May 15, 1945. This patient had had a known case of Hirschsprung's disease since birth. He stated that he had never had the power to move his bowels, but since birth had evacuated his bowels by rectal irrigations. At the age of three he received daily rectal irrigations. At the age of four he "lost" a rectal tube in the large bowel, necessitating an abdominal operation to remove it. At the age of fourteen he was irrigated weekly. Until 1941 he was a frequent patient at various hospitals where he received many types of treatment, i.e., medicines, massage and electrical treatments. He was seen by many physicians and even chiropractors. In 1941 the patient had a right sympathectomy; the following year he had a left sympathectomy. Following these operations, he was able to pass flatus per rectum but there was no change in bowel movements.

In 1945 he joined the Merchant Marine. Prior to this he had had weekly irrigations performed by his mother. While working at sea, his irrigations were given only once a month. He ate a normal diet and seemed to get along all right with his work as long as he received irrigations once a month. Less frequent irrigations caused him to become distended with gas. Three months before his admission, because the ship he was on became winter-bound, the patient went seven weeks without a rectal irrigation. He developed marked abdominal distention and pains. He was taken to a local hospital where, under spinal anesthesia, the

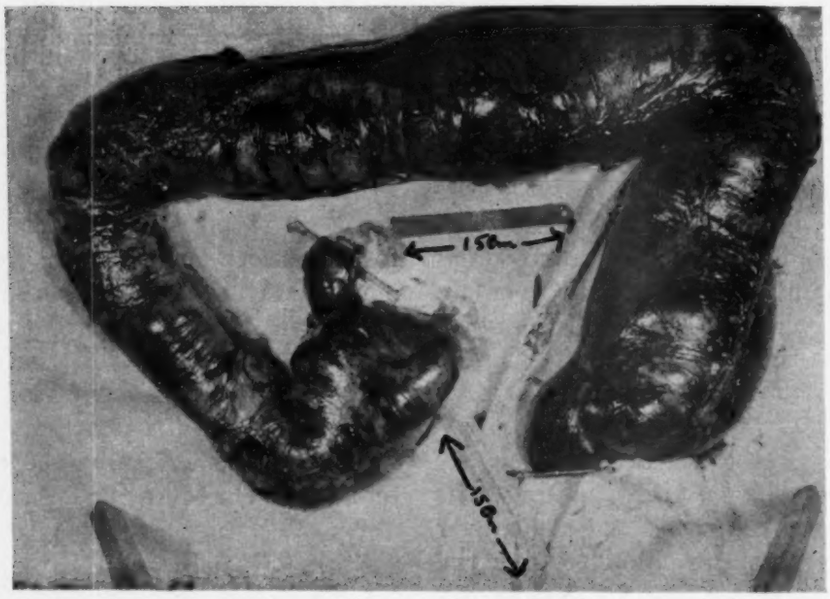

FIG. 1. Hirschsprung's disease. Photograph of a colon showing marked enlargement. It measured 32 cm. in circumference and was 190 cm. long. Histologic study revealed marked hypertrophy of the muscularis. There was no ulceration or exudation.

fecal matter was manually removed and the rectum irrigated. He apparently had some intestinal obstruction at that time.

He was transferred to another hospital but the distention was not relieved by additional irrigations and Wangensteen suction. He was then sent home. For the three weeks prior to admission to the Marine Hospital at Stapleton, N. Y. he had no solid food and apparently had been living on intravenous therapy. His admission was caused by failure to receive relief from high colonic irrigations given him by his mother.

The admission physical examination revealed an emaciated boy in moderate pain. Temperature was 100°F. and his abdomen was greatly distended. The skin over the abdomen was shiny and tense and loops of large bowel could be seen through the wall of the abdomen. There was some pain on palpation and percussion note revealed extreme gaseous distention with dullness in the flanks. Rectal examination revealed polypoid masses just within the sphincter. The sphincter was tight. Proctoscopic examination revealed an extrinsic obstruction just 6 inches inside the anus. X-ray of the abdomen revealed marked distention of the abdomen with gas. There was some increased density between the intestinal folds which was due to a slight amount of fluid or exudate.

Admission urinalysis was negative, blood serology was negative and the blood nonprotein nitrogen was 50 mg. per cent. After admission he was treated with enemas and Wangensteen suction and later a Miller-Abbott tube. In about one week he was comfortable and considered able to withstand major surgery. He was prepared with sulfasuxidine for five days preoperatively as well as with parenteral vitamins and fluids.

On December 29, 1944, a colectomy was done. Through a left rectus incision the colon was completely resected down to the lower part of the sigmoid. The distal end of the ileum was closed over and a side-to-side anastomosis was performed between the ileum and sigmoid just distal to a stricture found below the promontory of the sacrum. The open end of the sigmoid was brought out through the lower end of the incision.

On gross examination the entire colon was markedly enlarged, being four or five times the normal size. An impaction was found directly over the promontory of the sacrum with a stricture formation below.

Histologic study of the 190 cm. length and 32 cm. in circumference segment of colon revealed no ulceration or exudation but there was a hypertrophic muscularis. (Fig. 1.) The colostomy began draining profusely by the fourth postoperative day and by the sixth postoperative day he was having bowel move-

ments via rectum. The distention disappeared. The discharge via colostomy became progressively less until nearly all of the fecal matter was passing by rectum. He was out of bed in twenty-one days, with marked improvement in his general condition and an 8 pound gain in weight.

On February 19, 1945 (fifty-two days after colectomy) the colostomy was closed extraperitoneally. A barium enema was done on April 3, 1945, which revealed an adequate anastomosis opening. The distal ileum was reported as being dilated and "could be mistaken for large intestines, except that the haustrations were very close together."

At the time of discharge from the hospital on May 15, 1945, five months after admission, the patient was having regular bowel movements. He was seen for a follow-up examination in June, 1948, at which time he was having daily normal bowel movements and was maintaining normal weight.

CHRONIC ULCERATIVE COLITIS

Ulcerative colitis is a chronic disease of unknown etiology, characterized by diffuse inflammatory reactions in the wall of the colon or rectum. The disease is subject to remissions and exacerbations, complicated by necrosis, ulceration and sepsis and resulting in extensive fibrotic changes in the entire wall of the large intestine. In the early textbooks[16] it was described under the heading of enterocolitis or enterotyphlocolitis and was believed to be caused by unknown bacterial infections. Later, as bacteriology and parasitology developed, certain forms were found to be due to specific enteritis, such as bacilliary dysentery, amebic dysentery, tuberculosis, actinomycosis or lymphopathia venereum.

However, a relatively large number of cases of ulcerative colitis remained that could not be classified as being due to those causes and it is these non-specific cases that we speak of as true chronic ulcerative colitis. Some authorities still claim that there is no non-specific ulcerative colitis because if a careful search is made Endamoeba histolytica or Shigella dysenteriae will be found. From a practical standpoint, however, there remains a group of cases in which no etiologic agent is found to account for the colitis.

Everyone recognizes the marked psychogenic factors present in these cases but it is always difficult to determine which comes first. By the time the disease reaches the chronic stage, with irreversible changes in the gut wall, there is ample organic reason for psychiatric disorders. These cases vary in clinical characteristics from mild rectal disorders to severe fulminating toxic diseases leading to death. Two forms are recognized, i.e., an active form and an inactive or burnt-out disease. In both forms symptoms may vary from symptomless to complete invalidism.

In the active form inflammatory changes in the colon wall are progressive; in the inactive form the disease remains quiescent, but symptoms may be present if histologic changes in the bowel wall cause alteration of the physiology of the colon. It is this inactive type of case in which the surgeon is especially interested. As the colon experiences repeated attacks of infection and ulceration followed by healing and scarring the colon loses its original histologic characteristic and becomes a firm non-elastic tube, full of fibrosis and infection. The colon is then unable to perform its function and becomes a useless tube in which chronic infection has its source.

It is apparent then that the diagnosis of chronic ulcerative colitis is made by exclusion. The differential diagnosis should include: (1) Cancer of the rectum or colon. Cancer occurs in the older age group and has a shorter history (it occurs in those over forty years of age while ulcerated colitis commonly starts in the early twenties). (2) Bacilliary or amebic dysentery usually is more acute but can occur like chronic ulcerative colitis. (3) Tuberculous enterocolitis involves the terminal ileum and is more frequently associated with pulmonary tuberculosis. (4) Lymphogranuloma inguinalae involves the rectum. It is a granulomatous lesion and gives a positive Frei test. (5) Regional ileitis

involves the terminal ileum and gives a negative proctoscopic examination.

The characteristic symptoms of chronic ulcerative colitis are rectal discharge of bloody mucus and pus, with diarrhea and tenesmus. There are associated systemic symptoms caused by malnutrition, anemia and sepsis. The disease runs a long course, lasting for years and characterized by periods of recurrence and exacerbations.

Diagnosis is established by proctosigmoidoscopy and x-ray examinations. The mucosa of the rectosigmoid shows edema, scarring and small mucosal hemorrhages, with exudation from the mucosa producing the bloody mucous discharge. The changes are diffuse so that no areas of normal mucosa can be seen in the involved segment. This is in contrast to amebic dysentery in which normal mucous membrane is found between ulcers. When seen by x-ray, the extent of the diseased colon can be determined. The fibrosis of the bowel wall produces permanent narrowing, shortening and rigidity of the colon. Loss of haustral markings, loss of flexibility, narrowing of the lumen and coarsening of the mucosal pattern are changes produced by ulcerative colitis that can be demonstrated by x-ray.

Treatment of ulcerative colitis is principally medical until the disease has progressed to such an extent that the pathologic changes in the bowel wall are likely to become irreversible.

The surgical treatment of ulcerative colitis can be divided into three categories:

1. Emergency treatment—In acute exacerbation of ulcerative colitis the patient may develop such a degree of sepsis and emaciation that the involved organ must be put at rest without too much surgical shock. This is done by simple ileostomy. It can be done as the first stage of a colectomy.

2. Curative treatment, i.e., colectomy—When the involved organ is so diseased that it no longer performs its physiologic function, it becomes a means for the body to dissipate its strength, leading to anemia, malnutrition, avitaminosis, sepsis and even death. When healing of the infected and scarred wall can no longer take place, the only treatment possible is to excise the diseased organ. If this is done, the body is able to compensate by having the terminal ileum take over the function of the colon.

3. Treatment of malignancies—The third indication for surgery in ulcerative colitis is the development of cancer in the involved organ. Increasing attention must be focused on this complication of ulcerative colitis for it seems to be more common than previously reported.[3] Possibly more ulcerative colitis patients are now living long enough to develop this late complication.

The very nature of ulcerative colitis predisposes to malignant changes because repeated infections followed by attempts at healing, with production of polyps and scars, are some of the recognized factors that leads to production of malignant growths.

Case II. S. O., a forty-two year old white male, was first admitted to the Stapleton Marine Hospital on May 27, 1944, complaining of severe diarrhea of six weeks' duration. He was having nine to eighteen stools daily containing pus and blood. He had a 15 pound weight loss and was unable to continue with his work as a seaman. Past history and family history were non-contributory to his present disease.

Physical examination on admission was negative except for emaciation, fever and slight tenderness over the lower abdomen. Sigmoidoscopy revealed moderate congestion and areas of patchy adherent fibrinous material in the sigmoid. Barium enema revealed marked spasticity and irregularity of the sigmoid and descending colon. Irregularities also were noted in the hepatic flexure.

Under a medical regimen fever, diarrhea, and abdominal pains continued. An ileostomy was done on July 24, 1944, at which time it was noted that the entire colon and sigmoid was thickened and its serosa inflamed. The patient continued to drain blood and pus from the rectum and failed to gain any weight. His colon was irrigated daily using saline. The ulcerated areas seen in the sigmoid failed to

FIG. 2. Right side of colon in a case of chronic ulcerative colitis. Examination revealed longitudinal ridges of grey granulation in the mucosa. The remaining areas were studded with pinhead-sized polypi. The wall was 0.3 to 0.5 cm. thick and the serosa showed areas of puckering. Upon microscopic examination massive infiltration of monunuclear cells was noted in the mucosa and submucosa. The epithelium was partly eroded, but other areas were hyperplastic and showed hyperplastic papillae.

improve. On October 8, 1945, fourteen months after ileostomy, the right half of the colon, a portion of the transverse colon and the terminal ileum were excised. Examination of this colon showed longitudinal ridges of grey granulations in the mucosa and the remaining areas were studded with pinhead-sized polypi. (Fig 2.) The wall was 0.3 to 0.5 cm. thick and the serosa showed areas of puckering.

On microscopic examination massive mononuclear infiltration of mucosa and submucosa and many germ centers were noted. The epithelium was partly eroded but other foci were very thick and formed hyperplastic papillae. The eroded zones were covered with fibrin and pus and the bases were infiltrated with lymphocytes, plasma cells and erythrocytes. Fibroblastic repair was noted.

Two months later (December 3, 1945), the remaining colon was excised down to the lower sigmoid. The excised colon again showed an edematous wall diffusely infiltrated with plasma cells, eosinophils and lymphocytes. There was considerable fibrosis in the submucosa. The patient withstood these operations very well; however, he continued to drain a small amount of pus from the rectum and was unable to regain weight.

He returned to the hospital in July, 1946, two years after onset of the disease, and the remaining sigmoid and rectum was removed by an abdominoperineal resection. This segment of bowel showed the greatly thickened fibrotic wall with numerous small polypi present. This patient has made gradual improvement and after his last examination in October, 1947 he was able to return to his occupation as a seaman.

DIFFUSE POLYPOSIS OF COLON

Polyposis, polypoidosis, multiple adenomatosis or multiple polypoid disease of the colon was first described in 1863 by Virchow.[19] It is a relatively rare disease as shown by the fact that up to 1942 only 331 cases had been reported in the literature. Mayo and Wakefield, as quoted by McLaughlan,[11] reported that 4 per cent of the patients examined in the proctological section of the Mayo Clinic had one or more polyps but only 0.04 per cent had disseminated polyposis. It is seen not infrequently in autopsy of patients who have died of carcinoma of the colon or rectum (33 per cent of cases).[2]

The classification of Erdman and Morris[7] usually is accepted. They divided cases of polyposis into two classes:

1. Adult or acquired type, occurring in middle or late adult life, characterized by long history of colitis. This suggests the inflammatory basis of the disease. (In Kahler's series of chronic ulcerative colitis 10 per cent had polyposis.)[11]

2. Adolescent (congenital) type occurring in individuals in youth or young adult life. In these cases there usually is a distinct familial history, a hereditary disease first described by Harrison Cripps in 1882.[5] Later genetic studies[8] showed that it is transmitted by both sexes, attacks both sexes and appears to behave as a mendelian dominant. A peculiarity of this inheritable disease is that the polyps may not be present at birth in susceptible individuals but tend to make their appearance in childhood at puberty; (genetic mutation of somatic cells demonstrating the possible hereditary nature of cancer).

The importance of early recognition lies in the fact that with both types of polyposis of the colon the incidence of malignant degeneration is very high. Scarborough says, (quoted by McLaughlin).[11] "Probably no benign process has a higher incidence of malignant degeneration than colonic polyposis." In his collected series 50 per cent developed cancer. Hullsick reports 34.6 per cent malignant degeneration. One may consider that practically 100 per cent of patients with diffuse polyposis of the colon will develop cancer of the large bowel or rectum if they survive long enough. In the familial form this malignant transformation occurs early (at thirty to forty years of age).

Diagnosis of the disease can be made by digital rectal examination, sigmoidoscopy and x-ray studies of the colon with barium. The history usually is one of repeated attacks of bloody diarrhea, accompanied by crampy pain, anemia and wasting away; even obstruction develops as a complication.

The treatment is entirely surgical. This surgery must be early and must remove the involved colon. Medical treatment consists in general measures to improve health and as a preoperative measure. X-ray therapy has been advocated as a means of treatment. There seems to be little reason for this for, although it may give temporary relief of symptoms, it does not remove the real danger, i.e., the malignant degenerative tissue. The x-rays are supposed to knock out the lymphoid tissue of the bowel wall causing it to scar down and this frequently is followed by passage of large number of polypi by rectum. The majority of patients treated with x-ray subsequently die of cancer. There are no reported five-year cures.

The surgical approach to the disease was first reported in 1900 by Lilienthal[11] who did an ileosigmoidostomy followed by a colectomy.

In 1923 Coffey[11] first reported a case treated by permanent ileostomy, followed by complete resection of colon and rectum. When the polypi in the rectum and rectosigmoid are not too numerous to permit their removal by fulguration through a sigmoidoscope, the operation of choice is to perform an ileosigmoidostomy followed by resection of the entire remaining colon as in the case reported here. When sigmoidoscopy reveals the presence of innumerable polypi, the only possible treatment that will save the patient from multiple cancers of the colon is a permanent ileostomy followed by resection of the colon and an abdominal perineal resection of the rectum and sigmoid.

It is apparent, therefore, that repeated proctosigmoidoscopy is essential in any case in which the rectum is left intact. Until recently the morbidity and mortality rates of treatment of the disease have been high. In 1928 Hullsick[10] reported a 47.2 per cent mortality rate with all forms of treatment. In 1943 McLaughlin[11] reported a 6.9 per cent mortality in patients treated with resection of colon, showing the progress of surgery, anesthesia and medical care pre- and postoperatively in colon surgery.

Case III. J. R., a forty-six year old white seaman, was admitted to this hospital on August 14, 1944, and was discharged on January 17, 1945. Past history was non-contributory; there was a strong family history of cancer. His mother died of cancer of the liver and his father died of an abdominal cancer of an unknown type. An uncle, two aunts and a grandmother had intestinal cancer. During childhood the patient was supposed to have had amebic dysentery. On admission he gave a history of "stomach trouble for 20 years." His bowels have always been loose; he has had repeated episodes of bloody diarrhea coming on every few months, with free intervals for as long as two years.

In 1935 he was diagnosed as having chronic ulcerative colitis and was put on a medical regimen and diet. In 1937 he was told he had amebic dysentery and was treated with "shots," with some improvement. In 1941 he was diagnosed as having multiple polyps of the colon and an operation was advised but the patient refused. He had mild attacks of diarrhea dur-

ing which he would become run down and lose considerable blood. The attack which finally brought him to the Marine Hospital at Stapleton had been going on for five weeks and consisted in ten to fifteen bloody stools a day. He first noticed soreness in the right and lower quadrant and later in the right upper quadrant. He had no pain or tenesmus with bowel movement.

Physical examination on admission revealed a well developed white male with tenderness over the entire abdomen, most marked in the right lower quadrant. Temperature was normal; urinalysis, negative; blood serology, negative; stool repeatedly negative for ova or parasites; red blood count, 3.01 million; hemoglobin, 9 Gm.; white blood count, 13,050, with 6 per cent polynorphonuclears.

Barium enema x-ray study on August 10, 1944, revealed no delay in passage of the barium into the colon, but there was a generalized honeycombing appearance of the distal two-thirds of the colon and a large persistent filling defect in the lower one-half of the descending colon just above the level of the ileum. The roentgenologist's impression was extensive polyposis with at least one enlarged polyp in the descending colon. Sigmoidoproctoscopic examination on August 22, 1944, and on September 5, 1944, revealed no evidence of ulceration or polyps in the terminal sigmoid or rectum.

On September 12, 1944, the abdomen was opened through a left rectus incision. The colon was resected from the right side of the transverse colon to the pelvic brim. The cut end of the transverse colon was then brought out through the upper end of the wound and the lower end of the colon was brought out through the lower end of the wound after anastomosing the lower ileum to the lower sigmoid. This gave the patient an ileosigmoidostomy, a transverse colostomy and a sigmoidostomy.

On examination the excised portion of the colon was found to be 150 cm. in length. The whole mucosa was covered by innumerable fleshy protuberances 3 to 6 mm. wide and long, having small smooth patches of mucosa between them. There were three larger nodular papillomas 2 to 4 cm. in length. There was one crateriform ulcer 2.7 cm. wide with a deep base puckering the serosa. (Fig. 3.)

On histologic study of sections of the colon the mucosal papillary structures closely approximated the normal glandular tubules except in the larger masses. Here there were hyperchromatic nuclei and deficient mucus. The ulcer had an abnormal acini and infiltrative solid cords penetrating the muscularis. No metastatic tumor was found in the lymph nodes. Histologic diagnosis was: (1) papillomatosis of the colon and (2) adenocarcinoma (grade II) of the sigmoid.

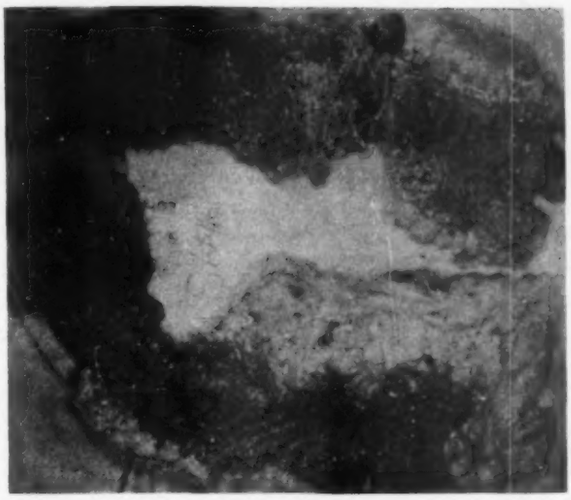

FIG. 3. Left side of the colon in a case of diffuse polyposis showing carcinomatous degeneration. The whole mucosa is covered with innumerable fleshy protuberances 3 to 6 mm. wide. There were 3 larger papillomas 2 to 4 cm. in length. There was one crateriform ulcer 2.7 cm. wide. This area had abnormal acini and infiltrative solid cords penetrating the muscularis on histologic study. The larger masses showed hyperchromatic nuclei and deficient mucus. The remainder of the tissue showed structures closely approximating the normal glandular tubules. Histologic diagnosis was papillomatosis of the colon and adenocarcinoma of the sigmoid, grade II.

Postoperatively the patient did well. He received blood transfusions and other supportive measures. The wound healed well and at the time of his discharge from the hospital on October 25, 1944, he was having normal bowel movements and the two colostomy openings were functioning.

He was re-admitted three weeks later for a second-stage colectomy. During the time he was out of the hospital he felt much better and had no pain. The colostomy was draining, requiring six to twelve dressings a day. On November 27, 1944, through a right rectus incision the abdomen was again opened. The terminal ileum was resected just distal to the previously done ileosigmoidostomy

and the free end was closed. The remaining ileum, ascending and transverse colon were then resected. This resected the upper colostomy, leaving the lower colostomy still in place.

On December 29, 1944, after sigmoidoscopy through the colostomy revealed no polyps the colostomy was closed extraperitoneally. His postoperative course, as happened in two previous operations, was uneventful and at the time of his discharge from the hospital on January 17, 1945, the patient was feeling well and his wounds were healed.

He has been followed periodically, the last time on August 2, 1946, when he was asymptomatic, having about three normal bowel movements per day. Barium x-ray studies of the colon taken July, 1945 revealed normally functioning enterostomy stoma, with no evidence of neoplasm.

SUMMARY

Colectomy is the chosen treatment in diffuse polyposis of the colon and Hirschsprung's disease. It is an effective means of treatment in later stages of chronic ulcerative colitis. Case reports are presented in which these diseases were successfully treated by colectomy.

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DISADVANTAGES OF DICUMAROL WITH SPECIAL REFERENCE TO THERAPEUTIC INADEQUACIES*

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THE increasing age of the surgical patient and the expanding magnitude of surgical procedures have given the complication of venous thrombosis, especially in the postoperative period, a wider field of importance. The literature of the past few years contains many excellent articles advising surgical ligation of the deep venous channels of the lower extremities while other reports extol the virtues of the anticoagulants, heparin and dicumarol. In many clinics[1–5] dicumarol is being employed as the anticoagulant of choice in the treatment of intravascular thrombosis. Its low cost and oral effectiveness have been chiefly responsible for its widespread popularity. The majority of physicians seem to prefer dicumarol to other anticoagulants although its disadvantages, such as delayed effect, necessity of daily prothrombin determinations and tendency to evoke hemorrhage have been well recognized. In this report attention will be called to several additional drawbacks to the use of this drug. For those who have had an opportunity to administer dicumarol to a large series of patients, it probably has proved to be adequate and convenient. On the other hand, many unfortunate experiences have been recorded in the literature and should serve as a warning to those unaccustomed to its limitations.

A study of our cases of thromboembolism leads us to emphasize certain other pitfalls encountered when dicumarol therapy is employed. These may be placed into four categories: (1) A standard dosage schedule is very difficult to formulate because patients display marked variability of response to the drug. (2) Not infrequently a dicumarol-induced hypoprothrombinemia, to the accepted therapeutic level, will fail to prevent thrombosis or will permit extension of an existing thrombotic process. (3) Blood transfusion and vitamin K therapy to correct a dangerous depression of plasma prothrombin by dicumarol may allow an extension of the thrombosis to occur before adequate anticoagulant therapy can be reinstituted. (4) Prothrombin determinations evaluating the degree of dicumarol effect are frequently misleading when heparin (for interim anticoagulant effect) and dicumarol are given simultaneously. This leads to inadequate dicumarol dosage.

All prothrombin determinations were performed in the hospital laboratory on diluted and undiluted plasma by the Quick method and are reported as per cent of normal in all instances.

In the general approach to the problem of thromboembolism it has been our practice to combine a strict regimen of both prophylaxis, and a search for postoperative venous thrombosis as an integral part of the routine postoperative care of all surgical patients. This includes elevation of the feet while the patient is confined to bed, leg exercises, early active ambulation, daily palpation of the calves and daily leg measurement.

THE VARIABLE RESPONSE TO DICUMAROL

Some authors[2,3,20] believe that the prothrombin level of the patient must be depressed below 30 per cent to control or to prevent intravascular thrombosis while others[4,13] maintain that a prothrombin deficiency between 30 and 60 per cent of normal is adequate. A large series of cases showing excellent results presented by

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Barker and Allen[2,3] of the Mayo Clinic would indicate that acceptance of a prothrombin of 10 to 30 per cent of normal as a desirable therapeutic range is warranted.

Various attempts have been made to simplify the plan of administration of dicumarol in order to keep the prothrombin level between 10 and 30 per cent of normal. Barker and Allen suggest that the entire amount of the drug for each day be given as a single dose. They recommend that 300 mg. be given on the first day, 200 mg. the second day, and on each succeeding day that the prothrombin is not lower than 20 per cent of normal an additional 100 mg. be given; however, if the prothrombin is lower than 20 per cent of normal, no dicumarol is administered on that day.

During the year previous to this report twenty-four patients with venous thrombosis received dicumarol at the University Hospital. The earlier patients were given dicumarol according to the above outline; however, it was noted that too frequently the prothrombin level fell into the hemorrhagic zone of less than 10 per cent. Later in the series 200 mg. were given as the initial dose followed by 100 mg. or 200 mg. the following day. Throughout the entire series the patients showed a marked variability of response to the drug. One patient received 200 mg., 200 mg. and 100 mg. on successive days. In four days his prothrombin decreased from 70 to 48 per cent. A second patient received two doses of 200 mg. on successive days and exhibited only a slight depression in prothrombin from 113 to 70 per cent. In contrast, two other patients received single doses of 300 and 200 mg., respectively, and within forty-eight hours had prothrombin depressions of from 64 to 12 per cent of normal and from 61 to 15 per cent of normal. In the first group 400 and 500 mg. produced no appreciable depression. Smaller doses in two similar patients produced prothrombin deficiencies almost to the hemorrhagic zone. One young healthy adult male with a prothrombin level of 90 per cent of normal was given 300 mg. of dicumarol. The following day the level was 25 per cent of normal and on the next day 28 per cent. One week after the initial dose there was still a prothrombin depression to 48 per cent. These patients exhibit extremes in the degree of response to dicumarol.

Barker[2] had many patients who were sensitive to dicumarol and whose plasma prothrombin level fell to less than 10 per cent of normal after 300 mg. to 500 mg. of dicumarol. Twenty-seven per cent, or 97 of 343 patients, exhibited this sensitivity.

This variability in sensitivity to the drug has been mentioned[5,13,19] by several other authors as one of its disadvantages. The individual variation of different patients is so great that a workable dosage schedule for administration is difficult to formulate. Many of the patients in whom prolongation of the prothrombin time is desirable are acutely ill. It is dangerous to spend several days in trial and error to determine the adequate maintenance dose for the individual patient.

It should be re-emphasized that there exists a marked difficulty in producing a hypoprothrombinemia in the so-called safe therapeutic range between 10 and 30 per cent of normal. This variation in response to dicumarol definitely detracts from its desirability as an anticoagulant.

FAILURE OF HYPOPROTHROMBINEMIA IN THE ACCEPTED THERAPEUTIC RANGE TO PREVENT THROMBOSIS

Many conditions such as fractures of the hip or pelvis, carcinoma in the lower abdomen, pelvic infections and certain blood dyscrasias, especially in the elderly patient, predispose to thrombosis.[16] There is an increasing tendency to institute some form of prophylaxis in the form of venous ligation or anticoagulant therapy to protect this type of patient. It is generally believed that a dicumarol-induced prothrombin depression to 30 per cent or less is sufficient to protect against the development of thromboembolic disease. One

patient in our series developed phlebothrombosis under such conditions. The case report follows:

CASE I. E. G., a sixty-four year old white female, was admitted with a diagnosis of carcinoma of the rectum and diverticulosis of the colon. On January 16, 1947, a one-stage abdominal perineal resection was performed. At that time her prothrombin level was 83 per cent of normal. On the following day dicumarol (200 mg.) was given and for the next three days 100 mg. were administered daily. The prothrombin level on January 20th was 80 per cent. On January 22nd and 23rd it had fallen to 15 and 14 per cent, respectively. On the evening of January 22nd the patient developed severe pain in both calves. Homan's sign was present bilaterally. The following day there was marked edema of the right calf and a rise in temperature and pulse rate. A diagnosis of bilateral phlebothrombosis of the deep femoral veins was made. The dicumarol was discontinued and heparin was administered intravenously for three days. The clinical signs completely subsided; however, it was then decided in view of the patient's age and general condition that surgical ligation was indicated. Accordingly, she was taken to the operating room and both superficial femoral veins were tied. A large thrombus was removed from the right superficial femoral vein. The patient's recovery was uneventful.

This illustrates a failure of dicumarol to prevent the development of intravascular thrombosis even during a period of sufficient hypoprothrombinemia. Two other cases receiving prophylactic therapy developed thrombosis. One of these patients who received 300 mg. of dicumarol experienced a pulmonary embolism while the prothrombin level was 36 per cent, and another who received 500 mg. of dicumarol developed a phlebothrombosis while the prothrombin was 36 per cent. Although insufficient dicumarol had been given to produce a depression in the suggested therapeutic range, the plasma prothrombin approached 30 per cent. The two cases of almost adequate therapy, in addition to the one case in which the prothrombin insufficiency was considered safe, stress the dangers of undue faith in dicumarol as prophylaxis against intravascular clotting.

EXTENSION OF VENOUS THROMBOSIS DURING ADEQUATE ADMINISTRATION OF DICUMAROL

Twenty-four cases of phlebothrombosis were treated with dicumarol. One patient developed an extension of the intravascular thrombosis and one developed a pulmonary embolus while the prothrombin levels were less than 30 per cent of normal. Reports of these two cases follow:

CASE II. B. H., a thirty-five year old male, was admitted on June 17, 1947, with the complaint of pain in the left chest and cough of two days' duration. The clinical impression was acute fibrinous pleurisy or pulmonary infarction. On the seventh hospital day the patient developed severe pain in the left calf with edema and marked tenderness of the left leg. This was the first concrete evidence of venous thrombosis. He was started simultaneously on dicumarol and intravenous heparin. Heparin was discontinued on the second day when the plasma prothrombin level had fallen with 300 mg. of dicumarol to 22 per cent of normal and after the clinical signs of thrombosis had subsided. On the third day with a prothrombin of 20 per cent marked pain with severe tenderness was noticed in the left calf. There was increased edema of the left leg and ankle. These signs were believed to be clinical evidence of the extension of the thrombosis following cessation of heparin therapy. The prothrombin deficiency induced by dicumarol had failed to prevent an increase in the thromboembolic process. Dicumarol was discontinued and anticoagulant therapy was continued with subcutaneous heparin in gelatin.* The clinical signs of thrombosis subsided and the patient was discharged two weeks later.

CASE III. P. W., a forty-six year old male was admitted with a diagnosis of carcinoma of the bladder. On June 3, 1947, the ureters were catheterized and a biopsy of the bladder tumor was made. Fifteen days later he developed a phlebothrombosis of the right leg. Intravenous

* Heparin in gelatin (Dep-Heparin) was supplied for this study by the Upjohn Company, Kalamazoo, Michigan.

heparin therapy was given for three days. Two hundred mg. of dicumarol were given on both the second and third days. On the fourth day the prothrombin was 11 per cent and all signs of thrombosis were receding. Heparin was then discontinued. On the morning of the next (fifth day) the prothrombin level was 13 per cent. About 6:00 P.M. of that day, the patient complained of pain in the right popliteal space and in the right calf. There was a definite increase in the size of the leg and marked evidence of extension of the thrombosis. This case responded to heparin therapy; but when heparin was discontinued after dicumarol-induced hypoprothrombinemia of less than 30 per cent had been established, an extension of the thrombosis occurred. The dicumarol was discontinued, and the patient was given subcutaneous heparin in gelatin. He experienced an uneventful recovery.

In this series of twenty-four cases of dicumarol-induced hypoprothrombinemia the incidence of failure to prevent extension of the thrombotic process is 8.3 per cent. In surveying the literature for reports of similar experiences it was found that no special attention had been called to the incidence of failure although several authors[10,11,13,14,16,17,18] reported similar difficulties encountered in their series. In an attempt to compute the percentage of failures in other clinics the reports were meticulously reviewed to ascertain the adequacy of the dicumarol therapy. A tabulation of some results of previous investigations has been made. Only those cases in which the author stated that a prothrombin depression to 30 per cent or less of normal had been maintained have been included. Table 1 lists the percentage of failures occurring during so-called adequate hypoprothrombinemia in the treatment of an existing thromboembolic process.

There are many reports in the literature concerning the failure of dicumarol to prevent the development of thrombosis and pulmonary embolism; however, the depression of the plasma prothrombin in many of the cases had not been in the currently accepted therapeutic zone. In the preceding paragraphs the difficulty in maintaining adequately depressed plasma prothrombin has been emphasized. It is generally agreed that patients who do not show an adequate prothrombin depression by dicumarol may develop a thrombosis or have an extension of an existing thrombosis. It is clear that the same may occur in spite of the depression of plasma prothrombin to the presently accepted therapeutic level.

TABLE 1

Author	Year	No. Cases	Failures	Per Cent
Wright and Prandoni[18]	1942	10	1	10.0
McRoberts[11]	1942	10	1	10.0
Wasserman and Staats[13]	1943	49	3	6.1
Eckstam[14]	1944	23	1	4.4
Barker[17]	1946	572	8	1.4
O.S.U. series	1947	24	2	8.3
		678	16	2.3

THE DEVELOPMENT OF PULMONARY EMBOLISM OR EXTENSION OF THROMBOSIS AFTER TRANSFUSION FOR EXCESSIVE DEPRESSION OF PLASMA PROTHROMBIN BY DICUMAROL

One case of interest illustrates a hazard which may confront the physician who chooses dicumarol therapy.

CASE IV. P. T., a thirty-six year old white male, was operated upon September 23, 1946, for a retroperitoneal tumor (Hodgkin's granuloma). Prophylactic anticoagulant therapy was started. Twenty-four hours after operation he was given 300 mg. of dicumarol and on the following day 200 mg. of dicumarol. On the third day the prothrombin level fell to 10 per cent. Fear of hemorrhage prompted the administration of intravenous vitamin K and a fresh whole blood transfusion. In twenty-four hours the prothrombin level rose to 60 per cent. Dicumarol was readministered but before the prothrombin had again been depressed to a safe level the patient developed a non-fatal pulmonary embolus. This incident occurred thirty-six hours after dicumarol therapy was reinstituted.

The fear of hemorrhage when the prothrombin lies in the zone below 10 per cent of normal is apt to evoke the immediate administration of coagulant therapy which frequently elevates the prothrombin level above the safe therapeutic range. This may allow a thrombosis to form before an adequate hypoprothrombinemia can be reinduced. The use of vitamin K and whole blood transfusion, when an alarming prothrombin level is reached, must be judiciously considered unless hemorrhage is present for this therapy may prove a sin of commission. Whole blood will restore the prothrombin for a period of four to six hours. Its effect seems to be due to a replacement of plasma prothrombin.[2] Intravenous vitamin K reaches a marked effect in two hours and a maximum effect in eighteen hours.[20] It is imperative that a careful watch be kept over the rising plasma prothrombin to prevent a prolonged period during which the level is above 30 per cent. It must be remembered that should the plasma prothrombin approach normal, forty-eight hours may be required before renewed dicumarol therapy will become effective and there is thus a latent danger of extension of thrombosis and pulmonary embolism during this period.

MISLEADING PLASMA PROTHROMBIN DETERMINATIONS DURING SIMULTANEOUS HEPARIN AND DICUMAROL THERAPY

A standard anticoagulant regimen in many clinics is to administer heparin and dicumarol for a period of two to three days until dicumarol has depressed the plasma prothrombin to the desired level. If blood is drawn too soon after the intravenous administration of heparin, the prothrombin level may appear therapeutically depressed. This apparently low prothrombin level in heparinized blood of patients receiving dicumarol is quite misleading. By the very nature of the Quick test it seems logical that the antiprothrombin and antithrombin properties of heparin would influence the clot formation, which indicates the end point in the laboratory determination of plasma prothrombin. This seems obvious since the prothrombin test measures the coagulation time of recalcified plasma in the presence of excess thromboplastin.

Long, Hurn and Barker[21] have demonstrated the effect of heparin on the prothrombin time. They have shown that a high level of heparin in the blood which produces a greatly increased coagulation time considerably affects the apparent prothrombin level. We have verified this by demonstrating in several cases prothrombin levels of 12 and 18 per cent when the blood was drawn within an hour after an intravenous injection of heparin, and levels of 40 to 60 per cent in the same cases two to three hours later.

A simple experiment can be performed for demonstration. Blood drawn from a normal individual in a dry syringe will show a normal prothrombin level. If blood is drawn from the same individual in a heparinized syringe (1 cc. of 10 mg. of heparin is drawn into the syringe then pushed out leaving only a minute amount of heparin solution along the wall of the syringe), there will be a marked increase in the prothrombin time. Small amounts of heparin intravenously do not appreciably effect the prothrombin level. Our experience has been that the heparin level must be sufficient to produce a prolongation of the coagulation time (Lee and White) beyond forty minutes before a marked effect on the prothrombin time is obtained.

A false sense of security is thus experienced when an apparent prothrombin depression to the safe therapeutic range is obtained on heparinized blood. The heparin effect will disappear in two or three hours and the true prothrombin level may be well above 30 per cent of normal. It is necessary, therefore, that blood for prothrombin tests be drawn at least three hours after an intravenous dose of heparin (or when the Lee and White coagulation time is below forty minutes) if an accurate

determination of the dicumarol effect is expected.

Although heparin is more expensive, it can be administered and controlled almost as economically as dicumarol if the cost of the daily prothrombin test, essential to sound dicumarol therapy, is considered. In our opinion the subcutaneous administration of heparin in a gelatin menstruum[9,10,22] requiring only infrequent, easily performed coagulation time determinations, may eventually prove to be superior.

SUMMARY

1. A study of the problem of venous thrombosis during the past year has disclosed several failures of dicumarol therapy, namely: (1) Too often the unpredictable response of the patient to dicumarol makes it very difficult to maintain the prothrombin level in the suggested therapeutic range of 10 to 30 per cent of normal. (2) Even when a prophylactic prothrombin depression has been maintained within the therapeutic range, thrombosis may occur. (3) Case studies have been presented of two patients with thrombosis in whom the thrombotic process extended in spite of a dicumarol-induced hypoprothrombinemia of less than 30 per cent of normal. (4) A transfusion of whole blood to rectify excessive depression of plasma prothrombin by dicumarol may increase the coagulability of the blood sufficiently to allow thromboembolism to occur.

2. The dicumarol effect, as evidenced by the Quick prothrombin test, may be most inaccurate if determined on blood containing moderate amounts of heparin. This is due to the effect of heparin on the end point of the test.

3. Although dicumarol has been the popular anticoagulant in this country for several years, the newer preparations of heparin in a gelatin menstruum may prove safer and more dependable.

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THE COMMON NON-VASCULAR NEVI AND THEIR TREATMENT*

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THE various forms of nevi both pigmented and non-pigmented are very common. Every individual has many; some may have hundreds of them. The following anatomic and clinical classification (Table 1) includes the majority of these lesions.

The flat pigmented spots and patches may or may not contain neval cells. When the pigment is found in patches in the basal layer of the epidermis and in the protoplasm of the dendritic cells of the reti, these pigmented spots are called epithelial nevi. A freckle is such an example. When the pigmented spots also have neval cells, they are real pigmented nevi. If they are superficial and do not contain hair, they are known as nevus spilus.

The pigment in these nevi is melanin. It is an iron-free chromoprotein, probably a metabolite of pyrocatechol. Its precursor is shown by exposing unfixed, frozen tissue to a solution of dioxyphenylalanine whereupon pigment granules become visible in

TABLE 1
NON-VASCULAR NEVI

I. Benign Lesions
- A. *Flat lesions*
  - (1) Pigmented spots and patches
    - (a) Epithelial nevi
    - †(b) Nevus spilus
- B. *Raised lesions*
  - (1) Hard nevi
    - ‡(a) Nevus verrucosus linearis
    - (b) Hyperkeratotic nevi (congenital warts)
  - (2) Soft nevi
    - †(a) Nevus verrucosus (nevi covered with hard or soft papillary excresences)
    - ‡(b) Nevus papillomatosus
    - (c) Fibroma pendulum
    - †(d) Hairy, warty nevus
    - †(e) Pigmentary nevi (soft moles including non-hairy and hairy moles, nevi pilosi, nevi sebacei)
      - (1) Hairy nevi (nevus pilosi)
        - (a) Small, soft, hairy nevi
        - (b) Giant nevi (bathing trunk nevi)
      - (2) Non-hairy nevi (black, bluish black, or brownish moles)
      - (3) Fatty nevi (nevus lipomatodes)
      - (4) Fleshy pedunculated nevi
      - (5) Mixed types
      - (6) Unusual types (blue nevi, Mongolian nevi, depigmented nevi)

II. Malignant lesions

† Those containing neval cells.
‡ May or may not contain neval cells.

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the cells. This is known as the dopa reaction. Melanin is found in the protoplasm of many cells in the epidermis and in the dendritic cells of the corium. Some of these cells are capable of ameboid movement and may carry pigment to distal parts. The neval cell can produce melanin and may or may not exercise this function.

The true nevus is probably of nerve tissue origin and is a tumor of the tactile sense organ, the Meissner corpuscle. The neval cells have abundant nerve connections. The normal epidermis has numerous minute tactile organs (Merkel-Ranirer corpuscles) and non-medullated nerve fibers end in these. The Merkel-Ranirer corpuscles may account for some of the nevi which occur intra-epidermally. Another reason for supposing neval cells to be of nerve tissue origin is this ability to produce melanin. The production of melanin has long been known to be a function of nerve tissue. In lower animals it is under voluntary control as in the production of melanin in the ink sac of the cuttle fish and squid. Various lizards and fish in mimicry change their color to suit their environment.

The occurrence in neurofibromatosis of pigmented patches and pigmented nevi shows the close relationship of nerve tissue tumors to neval cell growth. Melanin formation is also under pituitary, adrenal and gonadal control. In Albright's unilateral cystic disease of bone accompanied by unilateral distribution of pigmented patches and pigmented nevi, precocious sexual development is present. Menstruation has been known to occur at two and three years of age.

In some fish the injection of the female sex hormone will cause the fish to assume color. This characteristic is made use of in a test for the detection of pregnancy. The effect of sex hormones on the production of melanin is seen in the development of pigmented nevi during adolescence and pregnancy. While pigmented nevi may be present on the skin at birth or shortly afterward, a great many do not make their recognizable appearance until after puberty. Pregnancy makes nevi darker. As a matter of fact, pregnancy has a tendency to make all pigmented patches become darker.

When the gonads are not very active, the growth potentialities of the nevi are not great; it is only when gonadal secretion is at its height that benign nevi may become malignant melanomas. While pigmented nevi are present in infancy and childhood, it is rare for malignant melanomas to develop before puberty. Malignant degeneration of benign moles occur frequently during pregnancy. At this time the melanomas grow rapidily and spread widely. That this activation is not the result of pigment formation is shown by the fact that the non-pigmented nevi are also stimulated to growth, and malignant melanomas derived from these are more malignant than those that produce melanin. The functional differentiation of the neval cell is the production of pigment. In the non-pigmented melanomas more of the energy may be exerted on cell production than on melanin production.

Other glands that play a part in melanin production besides the ovaries, testes and the pituitary body are the adrenals. In Addison's disease of the adrenal glands melanin patches are seen especially in the mouth.

At times pigmented nevi resemble clinically seborrheic warts (verruca senilis) and small patches of senile keratosis. The seborrheic warts which usually occur on the body can be rubbed or washed off without leaving bleeding points; the senile keratosis which usually occur on the exposed parts of the body will leave little bleeding points when the keratotic scales are scrapped off. The senile keratosis are usually smaller than the seborrheic warts, fewer in number and show signs of inflammatory reaction and occasionally induration. While the superficial layers of some of the verrucose nevi might be scrapped off, the base of the lesion is still present and can be identified easily. If the seborrheic warts ever become malignant, basal cell

carcinomas are apt to develop. The precancerous lesion, senile keratosis, usually develops a squamous cell carcinoma, while the pigmented nevus develops a malignant melanoma.

The hard nevi group, nevus verrucosus linearis and nevus hyperkeratotic, may or may not contain neval cells. Very often they belong in the group of epithelial nevi.

Soft nevi are raised or pedunculated with a smooth or furrowed or even warty (verrucous) surface. All the soft nevi, with the possible exception of the fibromas, are characterized histopathologically by the presence of neval cells.

Pigmentary nevi vary greatly in size from those scarcely visible or pinhead in size to giant moles involving extensive portions of the body such as the bathing trunk nevi. Those which contain hair are usually congenital and those which do not may be congenital or acquired. The pigmented nevi whether recognizable at birth or appearing later in life tend when once developed to remain as such without change in size or pigmentation. When such changes occur, transition to malignant degeneration must be suspected.

The two most common types of pigmented nevi are, first, the small deeply pigmented flat type (junction type of Traub) which may or may not contain hairs and which occur especially on the extremities; secondly, the soft, smooth, slightly elevated, moderately pigmented mole which may contain hairs and which is seen especially on the face, neck, trunk, thighs, buttocks and genitalia. Both are rarely over 2 to 3 cm. in diameter. These two are also the most important because they may become malignant. (Figs. 1 to 9.)

In 30 to 60 per cent of cases malignant melanomas arise from recognizable pigmented nevi. They arise principally from the superficial, flat, junction type of nevus and the slightly elevated pigmented nevus. But they may also occur in the ordinary hairy mole although Affleck[1] in a series of 317 cases of malignant melanoma found none which occurred in hairy nevi. In 266 cases they developed from pre-existing nevi. Hazen[3] found only a very few malignant melanomas developing from hairy nevi. A great many malignant melanomas arise from non-recognizable nevi either those which are amelanotic or from nevi which are so small or obscured that the patient does not have knowledge of their presence.

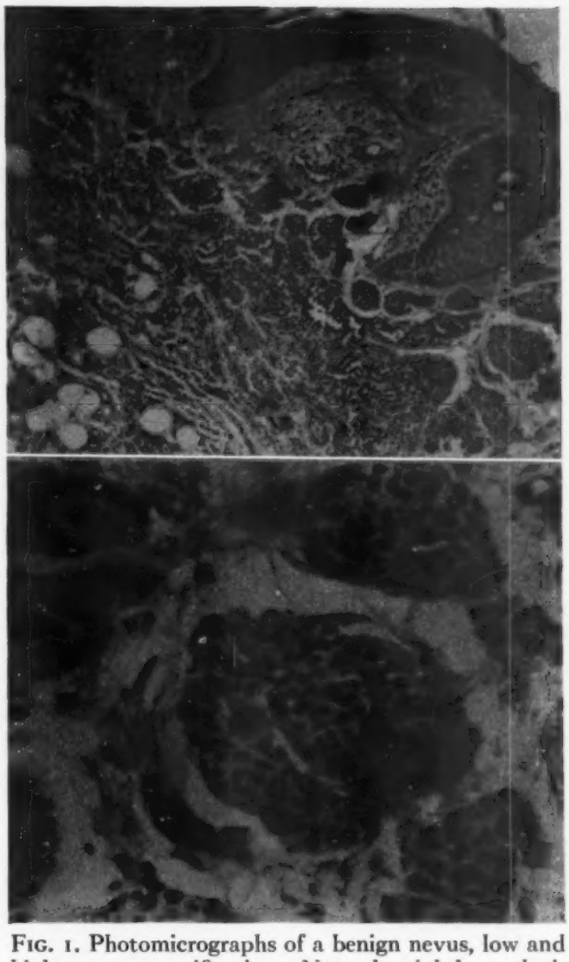


FIG. 1. Photomicrographs of a benign nevus, low and high power magnifications. Note the tightly packed, small, hyperchromatic cells. Occasionally in some soft fleshy moles the cells become atrophied and come to resemble fibrous tissue.

While most nevi become recognizable by puberty, some of the fleshy, pedunculated nevi may have their development delayed until later in life; this is particularly true in women in whom nevi may appear about the time of the menopause. Most of these nevi remain as tiny, unpigmented tumors which the body tries to extrude through the skin. They are seen as small filiform

2 3

FIG. 2. Same case as Figure 1. The patient had numerous non-pigmented moles of her face since birth. They looked more like papillomas. They gradually grew until they reached their present size. Biopsy taken from the large lesion on the chin showed the histologic picture seen in Figure 1.
FIG. 3. Same case as Figure 1 and 2 which shows a follow-up photograph four months after electrocoagulation removal.

excresences or tags which are nearly always confused with warts. They appear mostly on the neck, chest and perineum. A great number of these pedunuculated nevi, however, may not contain neval cells. Occasionally the neval cells become atrophied and come to resemble connective tissue cells.

The blue nevus is a sharply circumscribed, smooth, round or oval, indurated papule or nodule usually varying from 2 to 15 mm. in diameter occurring most frequently on the face and hands. There usually is a history of a solitary lesion which either has been present since birth or developed in infancy or early childhood and which has remained as such without increase in size. The blue nevus is a benign lesion but following trauma and inflammation may undergo malignant change. The blue nevus is characterized histopathologically by well formed mature dermal dopa positive melanoblasts having long bipolar dendritic processes laden with melanin pigment.

The Mongolian spot is much larger than the blue nevus and occurs as an ill defined, bluish to mulberry colored or blackish plaque, usually in the vicinity of the sacrum. It is present at birth but usually disappears in the third or fourth year of life. The Mongolian spot is also characterized by the dopa positive melanoblasts.

MALIGNANT TUMORS ARISING FROM NEVI

Not all malignant tumors occurring in benign pigmented nevi are malignant melanomas. Malignancy can occur in other than neval cells and new growths can arise from the basal cells and the squamous cells of a pigmented nevus. However, the most common malignancy is the malignant melanoma.

4 5

FIG. 4. The patient had this soft pigmented nevus since birth. It grew slightly with the years until it reached its present size. Histologically, the lesion was a benign pigmented nevus.
FIG. 5. Same case as in Figure 4 three months after electrocoagulation removal.

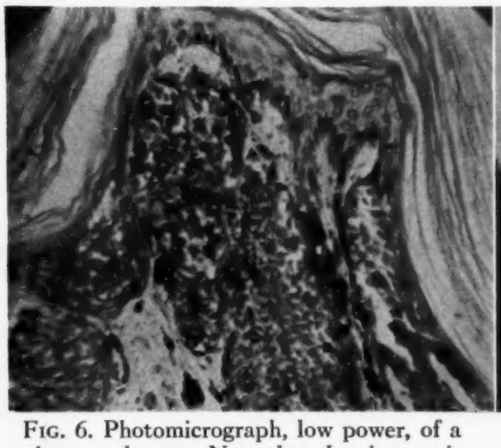


FIG. 6. Photomicrograph, low power, of a pigmented nevus. Note that the pigment is in the basal cell layer of the epidermis, in some of the cells of the corium and in many of the neval cells.

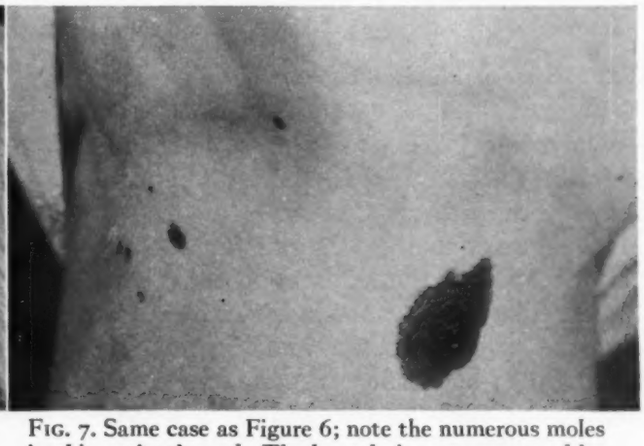


FIG. 7. Same case as Figure 6; note the numerous moles in this patient's neck. The large lesion was removed by surgery and the histologic section is seen in Figure 6.

Malignant melanomas may occur at any age from six months on; the average age of onset is fifty years. Malignant tumors of the skin are very rare among children but when they do occur they are apt to be malignant melanomas. However, Pack[4] says that before puberty malignant melanomas are not apt to metastasize. More than half of the malignancies arise from nevi that have been present at birth or shortly afterward. The nevi that appear in adult life are not of recent origin but make themselves visible at this time through increased growth and pigmentation. A great many of these also may give rise to malignant melanomas when fully developed

8 9

FIG. 8. Pigmented nevi in neurofibromatosis. Nevi appeared about the age of five in this patient. Neurofibromas were found mostly in the cervical region. The patient also had numerous bilateral cystic lesions in his bones.

FIG. 9. Same patient as in Figure 8.

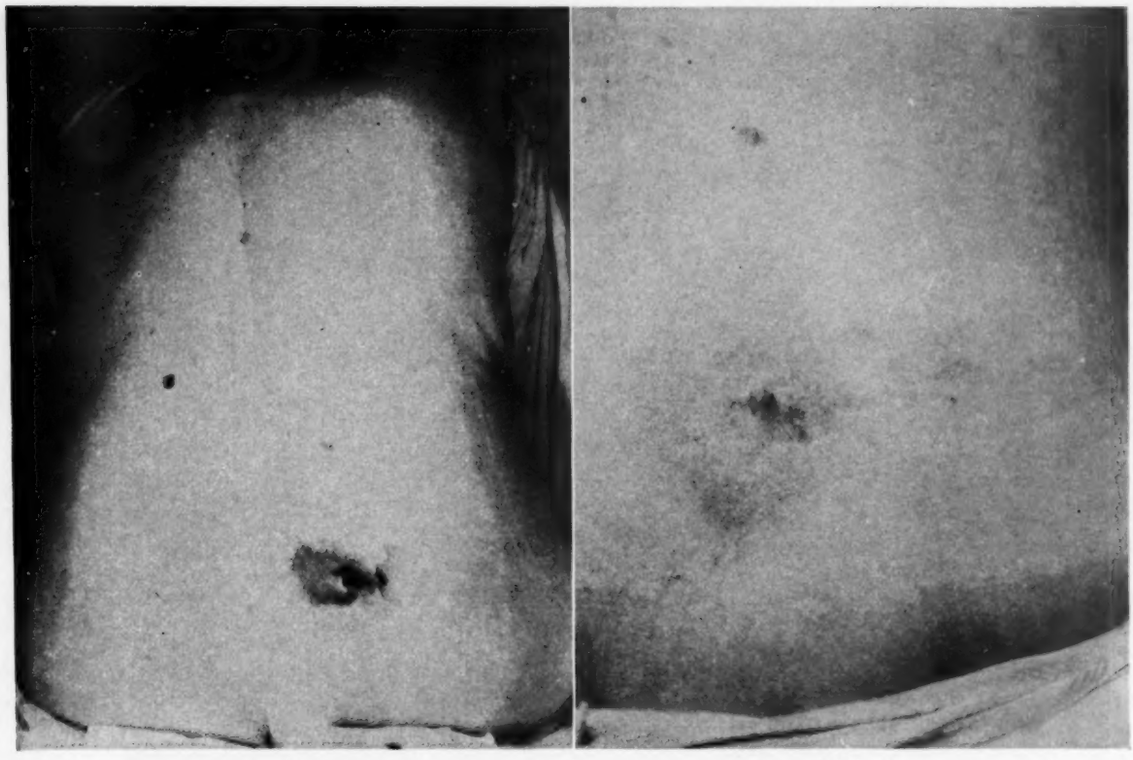
or even when latent, for many malignant melanomas arise in areas where no definite nevi are present.

The occurrence of malignant melanomas is about evenly divided among male and females. They rarely occur in negroes and when they do, they are most apt to be found on the least pigmented areas, namely, the soles of the feet, oral cavity and nail mattrix.

In a series of cases reported by Pack[4] 20 per cent of the malignant melanomas were found on the head and neck, 16 per cent on the foot, 18.7 per cent on the trunk, 8.7 per cent on the leg, 10.9 per cent in the eye, 6 per cent on the hand, 6.5 per cent on the arm, 1.3 per cent on the skin of breast, 1 per cent on the male genitalia, 3 per cent on the female genitalia, 1.3 per cent within the oral cavity and 2 per cent were of undetermined origin. Drs. Butterworth and Klauder[2] in 650 cases found malignant melanomas had developed from moles located as follows: head 16.5 per cent, neck 7.7 per cent, trunk 15.5 per cent, genital and anal region 2.7 per cent and the foot 52.3 per cent. (Figs. 10 to 16.)

PROPHYLACTIC TREATMENT OF NEVI TO PREVENT MALIGNANT DEGENERATION

The incidence of malignant degeneration of nevi is infinitesimal when the number of moles in existence is considered. However, the time elapsed between transition from a benign nevus to a malignant one is so very short (a few weeks or months) that often by the time the patient becomes aware of a change in character, metastases may already have occurred. For this reason prophylactic removal of nevi, especially the flat junctional type and slightly raised soft non-hairy lesions, should be done under any of the following conditions: Remove those that are darkly pigmented,



10 11

FIG. 10. Basal cell carcinoma in a pigmented nevus on the back. This patient has had this mole since birth. It gradually reached its present size. For the past six months a small, raised, ulcerative tumor occurred near the center of the pigmented patch. Biopsy showed basal cell carcinoma. The patient was diabetic and had heart disease so it was decided to try roentgen therapy.

FIG. 11. Same case as in Figure 10 three months after the lesion received 4,000 r. (200 r. 20 times) with the following factors: 200 peak kv., 0.5 mm. of copper and 1.0 mm. of aluminum filtration, 50 cm. skin focal distance and port to cover the pigmented nevus. Notice that the basal cell tumor is gone and that the pigment in the nevus is also disappearing. Pigment often disappears in pigmented nevi after both radium and roentgen therapy; however, radiation is too dangerous to use in treatment of pigmented nevi. Occasionally, pigment disappears in negroes in the areas treated by radium or roentgen rays.

either brown, black or bluish in color. Remove nevi appearing suddenly late in life or those occurring in areas subjected to trauma and irritation by clothing or occupation. Moles may be irritated by eye glasses, false teeth, collars, belts, suspenders, garters, rings and shoes. Moles on the inner sides of the thighs and legs may be irritated by horseback riding. Lesions on the hands and feet should be removed. Remove these lesions even if they are pale in color for they can give rise to the amelanotic malignant melanoma. These may be more malignant than the dark ones. Remove nevi which show increased pigmentation whether it be spotty or uniform. Remember that moles normally increase their pigmentation on exposure to sunlight, and that deepening in color during summer does not necessarily imply early malignancy; however, severe sunburn should be avoided. Remove those nevi that show a tendency to increase in size and elevation and those that show signs of hemorrhage and infection. Remove them if they cause pain. Those moles in scars from furuncles and carbuncles should be removed. A mole should be removed as soon as possible after trauma. Occasionally melanomas may develop six to eight months after trauma; this is especially true of those on the hands and feet. Do not wait until the melanomas have developed.

Huge brown, black or bluish nevi involving wide segments of the skin should be removed in infancy and childhood when the menace of malignant degeneration is usually absent. If the lesion is too large

12 13 14

FIG. 12. Squamous cell carcinoma in a pigmented nevus of the nose. This patient had had a pigmented nevus of the nose since birth, but in the past four months the center showed slight elevation and ulceration. Biopsy showed squamous cell carcinoma. Roentgen ray was given to the entire pigmented area.

FIG. 13. Same case as in Figure 12 eight months after 6,000 r. (300 r. 20 times) units were given with the following factors: 200 peak kv., 0.5 mm. of copper and 1.0 mm. of aluminum filtration, 50 cm. skin focal distance and port to cover the nevus. Notice that the pigment disappeared along with the squamous cell carcinoma.

FIG. 14. Pigmented nevus, malignant melanomatous degeneration. The patient was born with a pigmented lesion on the back of her neck. This always remained about the size of a ten cent piece. Seven years ago it began to darken and become bluer. For the next five years it gradually grew larger. Two years ago she visited a doctor who applied carbon dioxide ice on the mole. She had weekly applications for one and one-half years. The area increased in size in spite of the carbon dioxide ice. About one and one-half months ago several tumor areas grew out from the black mole and bled profusely.

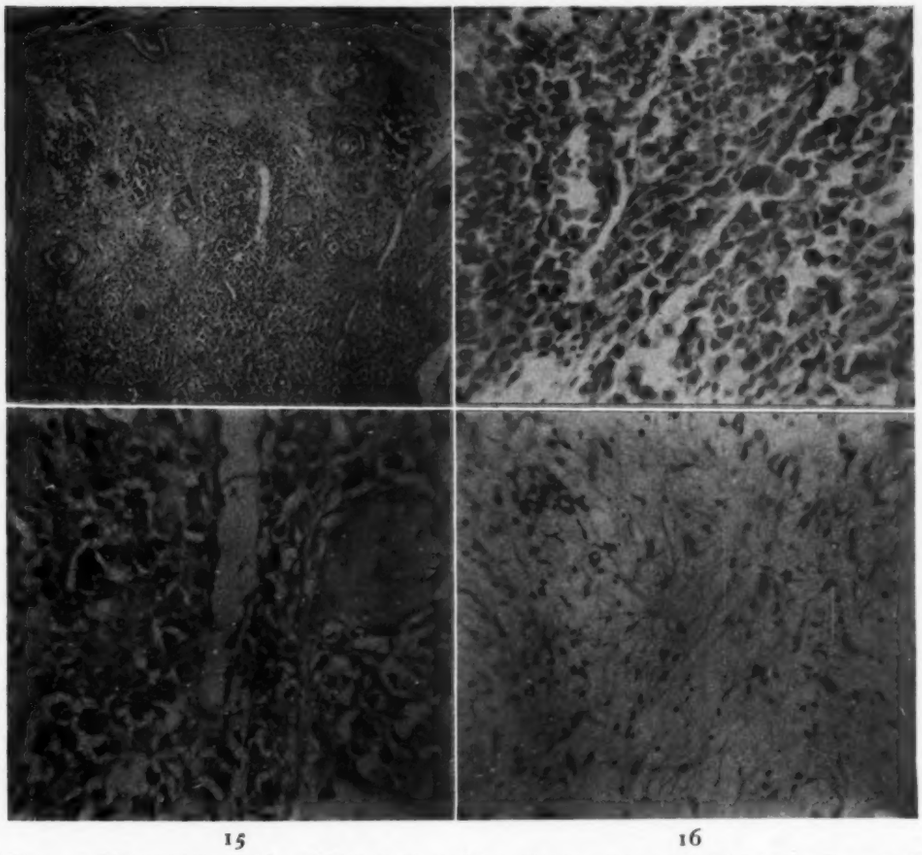
to remove in one stage with skin grafting, it may be done in several stages. A large ellipse of the tumor is excised from its center so that the scar of the approximated wound is a linear one running through the center of the remaining nevus. The second operation removes another ellipse with the previous scar. This can be repeated until the entire lesion is removed. While cutting through a nevus is safe before puberty, it is not safe to do this after puberty. Sufficient time is allowed between operations to permit stretching of adjacent elastic skin. In a child more stretching is possible than later in life.

The blue nevus which has deeper blue black color and a much deeper deposition of pigment than the pigmented mole is recognized as a much more dangerous lesion to handle. They are found most frequently on the face and upper extremities. However, although it is a benign lesion, when irritated to a malignancy this tumor and the Mongol mole form true melanosarcoma which metastasizes quickly and usually to the lung; therefore, remove the benign lesions early.

METHODS OF TREATING NEVI

Pigmented macules and patches are best left alone unless they must be removed for cosmetic purposes. Under local anesthesia they may be electrocoagulated. Surgical excision by scapel and electrocautery is used on hard and soft verrucous nevi.

Both complete and incomplete removal of pigmented and nonpigmented nevi by electrocoagulation is done thousands of times without mishap. However, treating a lesion in this way, especially when the lesion is incompletely removed, a recurrence of the lesion ensues once in a while and wide metastases follows very quickly. Of course this also occasionally follows what appears to be a complete surgical



15 16

FIG. 15. Photomicrographs of histologic section of same case as in Figure 14. Low and high power magnification shows malignant melanoma. The histologic picture of the tumor masses growing from this malignant nevus was similar to that seen in Figure 16. Very little pigment was present.

FIG. 16. Photomicrograph of histologic sections of a malignant melanoma before (upper photomicrograph) and after roentgen ray treatment (lower photomicrograph). The patient had a pigmented nevus removed from her leg. It promptly recurred along with extensive metastases to her groin. Many hundred metastases also occurred along the entire extremity. Roentgen ray therapy was given only as a gesture. However, the metastases gradually disappeared. The lower photomicrograph was taken in a pigmented metastatic lesion which was beginning to dry up and disappear. Notice the lack of any melanoma cells.

excision. It is hard to say whether the incomplete electrocoagulation stimulated a benign nevus to malignancy or whether the lesion was malignant all the while and therefore recurred. However this may be, there is no question about the fact that incomplete electrocoagulation of a malignant melanoma stimulates its growth and causes it to metastasize quickly. The open wound and secondary infection flare the malignant melanoma into greater growth.

The hairy nevus can be treated effectively by electrolysis and later by removing the nevus surgically. Some say that a hairy nevus seldom shows evidences of change toward malignancy. Even so, I believe that since some may develop malignant melanoma, they all should be removed especially when they increase in size and pigmentation.

Fatty, lobulated and pedunculated nevi should be excised.

The treatment of malignant lesions occurring in pigmented nevi is primarily a surgical one. I have treated patients with both basal cell and squamous cell tumors occurring in pigmented nevi in whom surgery would cause too much disfigurement, with both roentgen and radium therapy and the results were good. The

treatment of malignant melanoma is the removal of the primary lesion and its lymph-draining area. Radiotherapy of malignant melanoma should be done on hopeless cases not because many will be benefited, but because occasionally one is radiosensitive. I have seen one such cure. In a group of 217 melanomas treated with radiation Pack[4] reported a disappearance of the primary lesion in five patients and a diminution in size in forty-seven other lesions. Thus about 2.5 per cent of these lesions are radiosensitive and disappear. Others are somewhat sensitive and become smaller.

Pack[4] found that of 267 patients with malignant melanoma treated surgically only thirty-eight or 14.7 per cent survived five years. When a primary lesion was not too far advanced, their five-year cure in a group of seventy patients was 33 per cent.

In thirty-two patients with axillary metastases in whom axillary dissection was done nineteen subsequently died, thirteen are living and well, four for over five years. In a similar series of thirty inguinal dissections twenty-four patients are dead and only six are living and well, some for five years.

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TREATMENT OF PERITONITIS WITH PARENTERAL STREPTOMYCIN AND PENICILLIN*

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DURING the past few years various chemotherapeutic agents have been used in the treatment of peritonitis. Although the sulfonamides and penicillin alone or in combination lowered the mortality, there still was considerable room for improvement. Streptomycin given alone fell short of being ideal. In recent years considerable clinical, experimental and theoretic evidence has been accumulated which indicated that a combination of penicillin and streptomycin given parenterally would be of greater benefit than any previous method of treatment. Having used parenteral penicillin and streptomycin in the treatment of peritonitis, we are anxious to report our results. A survey of some of the data on which the choice of that mode of therapy is based appears indicated before describing our experience.

Most cases of peritonitis are caused by Escherichia coli, some strains of nonhemolytic or alpha-hemolytic streptococci and Escherichia welchii, in that order of frequency. The gram-negative bacilli are notably resistant to penicillin but are sensitive to streptomycin. Farris[1] and his co-workers reported on a group of animals with experimentally induced peritonitis. Ninety per cent of the controls died. All of the animals that received a single injection of streptomycin into the lumen of the appendix at the time of operation recovered. Ninety per cent of the animals that received parenteral streptomycin survived. In other animals 40,000 units of penicillin were placed in the lumen of the appendix at the time of operation; all survived. Two out of five rabbits that received penicillin parenterally died. It was concluded that penicillin was effective in preventing toxemia and death but apparently less effective than streptomycin.

Another laboratory study was conducted by Zintel[2] and his group. They reported a series of animals in whom experimental peritonitis had been produced. The results were as follows: (1) controls, 6.6 per cent survived; (2) parenteral streptomycin alone, 27.4 per cent survived; (3) local sulfonamide plus systemic penicillin and systemic sodium sulfadiazone, 40 per cent survived; (4) streptomycin parenterally plus the group of No. 3, 60 per cent survived; (5) systemic penicillin plus systemic streptomycin, 70 per cent survived. Zintel (May 1947) quotes Nichols as stating that the combination of streptomycin and penicillin had a synergestic action against certain bacterial organisms, an action greater than the additive effect of each.

The literature on peritonitis also contains reports of clinical investigations of the sulfonamides and new antibiotics. DeBakey[3] reviewed the Army experience with streptomycin. This survey included thirty cases of peritonitis in which the patients were treated by parenteral streptomycin. Twenty of these were of appendiceal origin. The results were as follows: twenty-four improved, three died and the rest showed no change. He concluded that streptomycin given alone does not produce dramatic results in peritonitis although its use as an adjuvant to standard surgical measures seemed justifiable. Nichols and Harrell[4] reported their experience with streptomycin in the treatment of peritonitis and concluded that "streptomycin may prove of value in some cases of peritonitis." Most

* From the Veterans Administration Hospital, Swannanoa, N. C. Published with the permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the authors.

of their patients were in advanced stages and that may have accounted for the statement that "our experience has been discouraging." Streptomycin was used parenterally and alone. The National Research Council[5] in its report on streptomycin discussed fifty-three patients with peritonitis of whom thirty-nine recovered, twelve died and two showed no effect. They concluded that the results were sufficiently encouraging to advocate using streptomycin in all cases of peritonitis in which the infecting organism was a susceptable one. They believed that it might be desirable to inject streptomycin into the peritoneal cavity if the infection was generalized.

Other authors have reported on the use of penicillin either alone or in combination with a sulfonamide. Imes[6] was able to study 243 cases of peritoneal penetration caused by missels. He believed that sulfonamides and penicillin appeared to be equally effective in the treatment and prevention of peritonitis, but was not impressed by the results of their local instillation into the abdomen. Griffin[7] and his co-workers advocated a combination of parenteral penicillin and oral sulfadiazine in the treatment of acute appendicitis. They had a mortality of 1 per cent in the treatment of 108 patients. Griffin also quotes Fauley as stating that in experimental peritonitis induced by the ligation of the appendix 92.6 per cent of the dogs died. If penicillin is given at the time of the operation, none of the dogs died; but if it was delayed for twelve hours, 21 per cent of the dogs died. Thomas[10] and his group also reported good results in the treatment of generalized peritonitis with parenteral penicillin. It remained for Crile[8] to advocate large doses of penicillin given parenterally to overcome the penicillinase formed by the gram-negative bacilli. He advocated 100,000 units of penicillin intramuscularly every two hours for two to six days, followed by a reduced dose for three to four days. He reported fifty cases of peritonitis of appendiceal origin with no mortality. Although his results were good, it is now known that many gram-negative organisms are resistant to penicillin even though they do not produce penicillinase.

Other data were available that enabled us to determine the dose of the antibiotics, their mode of administration and the frequency of injections. It has been well established that streptomycin has a pronounced effect on gram-negative bacilli while penicillin has a pronounced effect on the gram-positive cocci. A combination of the two appears to be ideal theoretically. It has also been established that both drugs appear in the peritoneal cavity promptly and in levels that equal that of the blood. Murphy[9] reported some experiments in which the peritoneal levels for streptomycin at times exceed the blood levels. Maximum serum levels of streptomycin are obtained one to three hours after a single intramuscular injection with a decrease over a period of ten to twelve hours. When streptomycin is given every four hours, there is a cumulative effect. On a dose of 0.4 Gm. every four hours a maintenance blood serum level of 16 micrograms per cc. is achieved. Crile[8] states that when 100,000 units of penicillin is given every two hours a blood serum level of 1.7 units per cc. is achieved in thirty minutes. In one hour the level is 0.8 units and in two hours 0.3 units. A level of 0.02 units of penicillin per cc. is effective in the control of most penicillin sensitive organisms.

We set up the following dose schedule for our patients: Each patient received 2 Gm. of streptomycin daily given in doses of 0.4 Gm. intramuscularly every three hours for five doses. In addition, 100,000 units of penicillin were given intramuscularly every three hours. These agents were continued until signs of improvement occurred although one of our patients had to discontinue penicillin because of a severe uncontrollable urticaria. A Levin tube was inserted into the stomach and hooked up to a suction apparatus if distention, nausea or vomiting were present. The patients were given at least 3,000 cc. of fluid paren-

terally if the Levin tube was used. Usually 1,000 cc. of normal saline were given plus amigen or plasma. Occasionally small blood transfusions were administered if the patient appeared toxic. No oxygen was used except for one patient who was extremely dyspneic. No special effort was made to have the patients in Fowlers position; any comfortable position was permitted. Occasionally a rectal tube was inserted to aid abdominal deflation.

Our present series is too small to be significant statistically. Nevertheless, our results have been dramatic and it was decided to make this a preliminary report and furnish representative cases as illustrating our experience. The first patient had a perforated duodenal ulcer of long duration. This was confirmed by operation. Although the perforation was not closed, the patient made a smooth postoperative recovery.

CASE REPORTS

CASE I. This patient was admitted October 14, 1947, with a history of having had severe epigastric pain for the past twenty-four hours. The admitting physician found slight tenderness in the right upper quadrant with a suggestion of a mass in the region of the right upper rectus muscle. The patient's general condition appeared to be good. The next morning the pain had radiated to the right lower quadrant and there was marked tenderness and rigidity along the entire right side of the abdomen. There was tenderness in the right loin posteriorly.

The abdomen was explored the following morning through a McBurney incision. The appendix was normal and there was a large amount of purulent material in this area. The incision was closed and a right upper rectus incision was then made. An ulcer was found in the duodenum perforating into the pancreas. There was a large amount of purulent material in the entire operative field. The pancreas was necrotic and friable in the region of its head and the muscles along the posterior right gutter were edematous and showed hemorrhagic changes. Because of the extreme number of adhesions and the friable nature of the pancreas and duodenum, the ulcer was not freed so as to permit closure. A drain was placed down to the site of the perforation and the wound was closed. Cultures of the pus obtained at the time of the operation were negative.

The patient was placed on routine treatment for peritonitis and given the two antibiotics in the recommended doses parentally. The drain was removed in six days. Both wounds healed nicely, the McBurney in one week and the right upper rectus incision in fifteen days. There was only slight distention of the abdomen during the first forty-eight hours. Following this, convalescence was entirely uneventful except for a slight elevation of temperature which persisted until the fourth postoperative day.

We were extremely impressed by this patient's course in view of the fact that there was a large amount of purulent material in the abdomen and a proven perforation had been found which was not closed. Nevertheless, the patient was successfully able to handle the generalized peritonitis.

CASE II. This forty-two year old white male was admitted to the hospital on September 24, 1947. About four days prior to admission the patient had developed pain in the epigastric region followed by vomiting. Several hours thereafter the entire abdomen had become painful with the maximum pain in the right upper quadrant. The pain radiated around the abdomen toward the vertebra posteriorly. There had been no bowel movement since the onset of pain. Extreme dyspnea and a nonproductive cough were also present. The temperature at the time of admission ranged between 101° and 102° F. and the pulse between 120 and 130. X-ray examination of the chest was negative. The white count was 22,100 with 89 per cent polymorphonuclears. The electrocardiogram was negative except for sinus tacchycardia. The patient was critically ill and showed marked distention of the abdomen, diffuse tenderness and rigidity over the entire abdomen and diffuse tenderness along the right posterior portion of the abdomen. Oxygen was required for marked dyspnea. A diagnosis of diffuse peritonitis was made, etiology undetermined. Several men had seen this patient and their diagnoses were as follows: (1) perforated peptic ulcer; (2) empyema of the gallbladder with perforation; (3) retrocecal appendicitis with perforation.

The patient received our treatment for peritonitis but continued critically ill for two

weeks. About that time marked tenderness developed over the lower costal ribs on the right both laterally and posteriorly. The x-ray also revealed a marked elevation of the right dome of the diaphragm. On October 13, 1947, a right subhepatic abscess was found and drained. Culture of the pus at that time showed Escherichia coli. Following drainage the patient continued to have an elevated temperature for three days but improved markedly. The abdomen became soft and the abdominal tenderness and rigidity disappeared. In three days the patient became afebrile and asymptomatic. Several weeks after drainage of the subhepatic abscess a gallbladder series was done and this revealed a non-functioning gallbladder.

This patient apparently had a generalized peritonitis of four days' duration. At the time of admission his condition was critical. Under supportive therapy and treatment with antibiotics the infection localized in the right subhepatic space where it could be drained. Following this, recovery occurred.

CASE III. This patient, a twenty-nine year old white male, was admitted on October 27, 1947, with a history of having had severe right lower quadrant pain for ten days. A diagnosis of acute appendicitis was made but the patient refused to enter the hospital. Vomiting was present the first few days but this ceased at the time of admission. The patient had had several severe chills. The pain in the right lower quadrant persisted with occasional radiations down the lateral aspect of the right thigh. During the last week of his illness the patient had had no bowel movement despite repeated enemas. At the time of admission the patient was acutely ill and showed diffuse tenderness over the right lower abdomen. Marked spasm and rebound tenderness were also present in that area. The patient's temperature ranged from 100° to 103.6°F. with the pulse varying from 80 to 100. The blood count showed 18,400 white cells with 86 per cent polymorphonuclears. A few of the examiners who had seen this patient thought that there was a suggestive mass in the right lower quadrant. A diagnosis of ruptured appendix with localized peritonitis in the right lower abdomen was made. The patient received our course of supportive therapy plus the two antibiotics. On November 1st the temperature had become normal and on November 5th no mass could be felt in the right lower abdomen. On November 3rd streptomycin and penicillin were discontinued and the patient was allowed out of bed. The remainder of his course during hospitalization was uneventful.

This patient had a localized peritonitis secondary to perforated appendix. The response to therapy was prompt and dramatic.

CASE IV. This patient, a white male thirty-one years of age, was admitted on August 4, 1947. Twenty-four hours prior to admission the patient developed abdominal pain of a rather mild nature. He vomited three times following the onset of the pain and had a temperature of about 100°F. He stated that he had had a similar episode during the past three years. He did not appear acutely or chronically ill and there was practically no tenderness on deep pressure in the right lower quadrant. The white count showed 10,800 cells with 85 per cent polymorphonuclears. The admitting physician made a tentative diagnosis of gastroenteritis. On August 6th the pain recurred and localized in the right lower quadrant. Marked tenderness was noted at this time with elevation of temperature. An appendectomy was done on August 6, 1947, and an acute gangrenous appendix with perforation was found. The operator stated that the cecum was markedly involved in the inflammatory process but there was very little generalized peritonitis reaction. The patient was placed on penicillin and streptomycin the day following operation. An infection of the wound developed postoperatively which drained pus containing Escherichia coli. The temperature ranged to 101–5°F. until August 15th, but there was never any but slight distention and the patient was able to pass gas from his rectum spontaneously. By September 3rd the wound had healed and the patient was discharged.

This is a case of a gangrenous perforated appendix treated by appendectomy. A wound infection developed but recovery occurred under our regimen of supporative therapy plus the two antibiotics. Unfortunately he received 150 mg. of streptomycin instead of the larger dose we now advocate. The larger dose may have prevented the occurrence of a draining wound.

CASE V. This patient, a white male, age twenty-four, was admitted on October 29, 1947. The day before admission he experienced pain in the epigastric area. This was followed by vomiting and radiation of the pain to the right lower quadrant. On examination there was

marked tenderness and moderate rigidity in the right lower abdomen. The appendectomy was done on October 29th and an acute suppurative appendix was found. Because of the difficulty in removing this appendix in the usual manner, the surgeon decided to do the appendectomy by the retrograde method. After ligating the base of the appendix and severing it distal to the ligature, the surgeon proceeded to work on the remaining portion of the appendix. During this procedure he noticed that fecal contents were appearing in the operative site. A search of the field revealed that the ligature which had been tied around the base of the appendix by one of the trainees had slipped off and that liquid cecal contents were appearing in the operative field. The wound in the cecum was closed in three layers but there had been moderate soiling of the peritoneal cavity before this could be accomplished. The patient was given our routine treatment for peritonitis plus parenteral doses of penicillin and streptomycin. Temperature ranged from 99° to 101°F. the following two days but was normal after that period. The pulse went up to 100 the first day but came to normal levels after that period. At no time was there any abdominal distention and the patient's general condition was very good postoperatively. The wound healed by primary union and he was discharged on November 7th.

During this study the question arose as to the dosage of streptomycin and its frequency of administration. Some of our patients received streptomycin in doses much smaller than those we now advocate or else at much longer intervals. The penicillin was administered in doses of 100,000 units every three hours but the patients received either 150 mg. of streptomycin every three hours or 0.2 Gm. every six hours. These patients did not do as well as we had hoped. Testing the organisms of each case of peritonitis for sensitivity to penicillin and streptomycin may be of aid in determining dosage.

CONCLUSION

There is clinical, laboratory and theoretic support for the combined use of parenteral streptomycin and penicillin in the treatment of peritonitis.

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TRANSTHORACIC TOTAL GASTRECTOMY FOR CARCINOMA OF THE STOMACH*

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IN the past the general attitude of surgeons toward carcinoma of the stomach was wholly pessimistic and it was generally thought that patients afflicted with this diesase were classified as hopeless. The reason for this pessimism was due to the fact that the patients did not consult the surgeon early in the disease and there was a tendency among medical men to procrastinate and treat these patients medically without realizing the consequences of lesions in the stomach. It takes careful analysis and cooperation among the patient, the practitioner and the roentgenologist to discover these cases early. Only early surgery will give a more hopeful picture in these cases in the future.

Schlatter in 1897 performed a total gastrectomy upon a patient who lived one year and fifty-three days and, subsequently, died of a recurrence. Finney and Rienhoff reported that until 1929 the mortality rate in all cases of total gastrectomy reported in the literature was 53.8 per cent. Subsequently, the mortality rate has been greatly reduced. Coller in 1943 reported a mortality of 10.5 per cent and W. P. Longmire, Jr. in 1947 reported twenty cases with a mortality of 10 per cent. In 1932 the resection rate for lesions of the stomach was 9 per cent whereas in 1939 it was 43 per cent and the mortality rate had decreased from 53.8 to 13 per cent in 1945.

It is evident, therefore, that these patients with carcinoma of the stomach do not have an entirely hopeless outlook at the present time. The reason for this is that we are resecting entire stomachs more frequently; this is made possible because of our greater knowledge of ánesthesia and our greater application of surgical technic with the use of chemotherapy.

At present we lean toward complete removal of the diseased organ. To accomplish this the surgeon must be familiar with the best possible approach for each individual patient. The transthoracic approach is a relatively recent addition in handling patients with cancer of the stomach. It gives free exposure and complete visualization of the field of operation and it therefore makes it possible to accomplish radical surgical treatment.

The transthoracic approach was based on the experimental work by Mickulicz, Sauerbruch and others during the period of 1895 to 1905. Adams and Phemister used this approach in 1938 for carcinoma of the lower esophagus and cardia of the stomach. Recently great impetus toward this approach for carcinomas of the cardia and fundus of the stomach and the esophagus was due to Garlock, Phemister and Churchill and Sweet. The technical advantages of this approach are now well established and the field has been expanded to include complete removal of the stomach with esophagojejunostomy as well.

The prognosis in total gastrectomy for carcinoma of the stomach is not too hopeful. At present we have no statistics based on a five-year postoperative basis. Churchill and Sweet reported ten survivals from the operation. Two died of recurrence and the remainder have been well three months to one and one-half years after the operation. Garlock reported twenty-two cases with nine deaths, of the thirteen survivors four died of recurrence from seven to thirteen months and nine were alive for periods of three months to two and one-half years after the operation. While we have

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no records as yet of five-year cures, we have at least been able to provide these patients with comfort during their survival period.

Gastrectomized patients do not react too badly to the absence of their stomach. Diarrhea is sometimes prominent and it is thought to be due to the removal of hydrochloric acid which normally has an attenuating effect on the bacterial flora of the upper gastrointestinal tract. Steatorrhorea may be present due to disturbances in fat digestion. There may be disturbances in the hemopoietic system such as secondary anemia although Waugh at the Mayo clinic reported a case of total gastrectomy which was done for a benign lesion. This patient is still alive after seven years but is now developing signs resembling pernicious anemia, such as glossitis and changes in the structure of the red blood cells.

CASE REPORT

The patient was a fifty year old white Russian female. She entered the clinic of the Cedars of Lebanon Hospital on October 9, 1946. Her chief complaint was pain in the epigastrium for the past two years, loss of weight for six months and loss of appetite for the past three months. She stated that she was perfectly well until two years ago when she developed moderate epigastric pain which was relieved by food. She consulted a local physician who had a gastrointestinal series taken which revealed a gastric ulcer. The patient was placed on an ulcer diet with medical management. About one year ago the epigastric pain became more severe and an additional gastrointestinal series was requested; it showed that the ulcer had become enlarged. The patient was allowed to continue on medical management. About six months before admission the epigastric pain became constant and aggravated by food so that minor relief of pain was experienced only for about thirty minutes between meals. Three months before admission the patient's appetite became poor and she lost about 6 pounds. For the next two months the pain increased in severity; therefore, she entered the clinic.

Past history revealed no serious illnesses. She was operated upon in 1939 for removal of a benign cyst in her left breast, and in 1941 she had a hysterectomy for a uterine myoma. A systemic review other than the gastrointestinal tract revealed no significant symptoms.

Physical examination revealed a slight, well nourished and well developed female. Systemic examination was normal outside of the abdominal findings which was tenderness in the epigastrium and the left upper quadrant. A large, irregular and firm mass filled the entire left mid-epigastrium, the left upper quadrant beyond the costal margin and higher than it was possible to palpate.

X-ray showed a large filling defect of the stomach resembling carcinoma. The other essential laboratory findings showed moderate anemia; blood protein: albumin, 2.7 Gm. and globulin 2.1 Gm.; 2 plus blood in stools.

The patient was prepared for surgery with blood transfusions, amino acids, proteins and vitamins. She was operated upon October 14, 1946, and because the mass extended so far above the left costal margin it was decided that the adequate approach would be through the transthoracic route.

Intratracheal cyclopropane anesthesia was used. An incision was made over the left eighth rib. The incision was developed through the layers and the eighth rib was removed. The seventh and ninth ribs were detached at the posterior attachments and the intercostal nerves ligated. The pleural cavity was entered and the left lung deflated. The pulmonary ligament was isolated and the esophagus was dissected free and followed to the hiatus where the diaphragm was incised and the peritoneal cavity was exposed. The left phrenic nerve was crushed. There was a large ulcerated and fungating lesion of the entire stomach. The stomach was adherent to the pancreas posteriorly. The spleen was removed. The left gastric and epiploic arteries were ligated. The gastrohepatic and gastrocolic omentum were ligated and the stomach freed from the pancreas and separated at the duodenum. The duodenum was closed with three layers of suture, using silk for the outer layer. The jejunum was freed at the ligament of Treitz up to the central mesentery so that the jejunum was brought up antecolic and anastomose to the esophagus without tension. Silk interrupted suture was used in all layers of the anastomosis. The proximal limb of the jejunum was folded over the anastomosis so that this portion was obstructed thus preventing regugitation of

FIG. 1. A barium meal taken five months after total gastrectomy shows an adequate esophagojejunal stoma. There is no dilatation of the esophagus and there is no barium in the proximal loop of the jejunum; there is normal progress of the meal.

alkaline juices postoperatively. An enteroanastomosis between the two limbs of the jejunum was then done. A Levine tube was passed through the anastomosis into the distal limb of the jejunum and that outer portion of the tube which emerged from the nares was sutured to the cheek to prevent possible accidental removal of the tube. The jejunal-esophageal anastomosis was sutured to the diaphragm. The diaphragm was sutured and before the pleural cavity was closed a catheter was inserted through the ninth interspace into the pleural cavity for underwater drainage. The lungs were inflated every twenty to thirty minutes as well as at the conclusion of the operation.

The postoperative course was essentially uneventful. The patient received adequate blood, penicillin, oxygen, intravenous glucose and electrolytes and about 3,000 cc. of amigen by continuous drip through the Levine tube.

The oxygen was discontinued after the third day and the pleural catheter removed after seventy-two hours. She developed a slight cough but no fever; a chest film showed a slight amount of fluid which cleared spontaneously in a few days. The patient was taking fluids on the fifth postoperative day and she was out of bed on the sixth postoperative day. The skin sutures were removed on the ninth postoperative day and at that time the patient was tolerating a soft diet and the Levine tube was removed.

The patient continued to improve and she was discharged on November 11, 1946. At the time of discharge she was on a large protein and low residue diet. The red blood count was 4,215,000; hemoglobin, 80 per cent; serum albumin, 4.1 Gm.; globulin, 3.9 Gm.; blood chlorides, 495 mg.; a cholesterol 222 mg. She was followed in the out-patient department and she continued to improve and gain weight. She has accommodated to several feedings of a general diet daily without distress.

Comment. This patient was treated medically for two years although her symptoms and x-ray findings suggested ulcer of stomach and early carcinoma. Not until this patient had a large, irregular mass that was palpable was she subjected to surgery. No doubt had earlier surgery been performed more could have been offered this patient. While the condition at the time of surgery appeared hopeless, radical surgery gave this patient comfort during her survival period.

CONCLUSION

Until recently carcinoma of the stomach was generally considered beyond the scope of radical surgery and these patients were placed in a hopeless group. At present we believe that: (1) surgery offers the only hope of cure; (2) palliative resection is worth while; (3) the mortality rate for total resection has progressively diminished due to improvement in technic, improvement in pre- and postoperative management and to improvement and advances in anesthesia and chemotherapy.

The case herein reported is that of a late case of carcinoma of the stomach, with total resection and esophagojejunostomy accomplished through the transthoracic approach. Five months after surgery there

was no evidence of recurrence and the patient was gaining weight and was free from distress.*

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* At this writing, which is twenty-two months since the operation, the patient is alive.

Gilbert and Dunlop of Edinburgh found that postprandial hypoglycemia was a rather common occurrence in patients recently subjected to partial gastrectomy. Clinically, these patients had vertigo, epigastric distress, weakness, sweating, etc., and the authors believe that this syndrome and the so-called "dumping" syndrome are identical. They believe that in each case the basic cause is the rapid absorption of food, especially carbohydrates from the jejunum. This syndrome, therefore, is more apt to occur when the patient's diet is especially rich in carbohydrates. This increased sugar absorption causes an increased insulin secretion and this is eventually followed by a temporary hypoglycemia. The authors therefore suggest that the meals of such patients should contain less carbohydrate and more fat. They also used 1 ounce of olive oil before meals, with resultant success. They also experimented with ephedrine in ½ gr. doses one-half an hour before meals, three times a day, with success. The authors also noticed that these symptoms could often be averted if patients received six smaller meals at more frequent intervals each day instead of three large meals. All these suggestions seem well worth while and this whole study merits further investigation and more consideration. (*Richard A. Leonardo, M.D.*)

CONTROL OF "INTRACTABLE PAIN" BY SPINAL GANGLIA BLOCK

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THE possibility and efficiency of controlling pain originating from the neck down by blocking the spinal ganglia with adequate anestheto-devitalizing solutions are based on definite anatomic and physiologic axioms and clinical results. The reasons why spinal ganglia block will succeed in controlling the modalities of pain, called intractable pain, when blocking or surgical destruction of other nerve structures have failed, will become self evident when the axiomatic data on which it is based are properly analyzed and interpreted.

The anatomo-physiologic data which are accepted as factual knowledge so indisputably that they can be considered as anatomo-histologic and physiologic axioms on the basis of which we can draw exact deductions concerning the effects of blocking of the spinal ganglia are the following:

1. The posterior roots are physically separated in the peridural space from the anterior roots and are composed of and contain all the afferent sensory cerebrospinal and sympathetic nerve fibers which peripherally form a most intricate intimate and complex network specially through the blood vessels.

2. The spinal ganglia are aggregations of nerve cells transforming that portion of the thirty-one pairs of posterior roots located in the peridural space close to the foramina conjugata into comparatively large spindle-shaped swellings.

3. The spinal ganglia are considered as peripheral sensory centers because they contain the cell bodies of all the afferent cerebrospinal and sympathetic neurons.

4. The cell body is the vital trophic center of the whole neuron.

5. In accordance with the Wallerian law, destruction, devitalization or temporary block of the cell body will, of necessity, be followed by simultaneous destruction, devitalization or temporary block of both the central and peripheral processes from the medulla to the tip of fingers and toes and the viscera. This means that all the physiologic and pathologic connections between other nerve structures whose cell bodies have been destroyed, devitalized or temporarily blocked, will per force also be destroyed, devitalized or temporarily blocked. In other words, the whole afferent neuron and its physiologic and pathologic connections will be put out of commission when its cell body is put out of commission.

6. The existence of the peridural space.

7. The physical possibility that anestheto-devitalizing solutions may be introduced in the peridural space with direct effect limited to the spinal ganglia.

8. The comparatively large size of the spinal ganglia practically blocking the posterior aspect of the foramina conjugata.

From the preceding axiomatic data we can logically deduce one of the unique characteristics of spinal ganglia block, i.e., that theoretically it is possible to obtain anesthesia from the neck down without affecting efferent motor structures.

It remains to be proven: (1) Why spinal ganglia block can succeed in controlling the modalities of pain known as intractable pain while blocking of or surgical interventions on other nerve structures fail to control them; and (2) a block limited to the spinal ganglia is clinically obtainable, effective and safe.

In order to understand fully the unique effectiveness and safety of spinal ganglia block one should consider the complexities of nerve structures and specifically the fact that these normal complexities become

perversely more complex when nerve structures are deeply affected directly and indirectly by complex pathologic conditions, such as malignancies. The evident intricacies and complexities of the peripheral processes of the sensory neurons, especially in relation to blood vessels, are generally well known while those of the central processes are less known. Therefore it might be useful to review briefly the most striking.

"Afferent Paths in the Spinal Cord. We have been at some pains to make clear the course and distribution of the dorsal root fibers within the spinal cord because all afferent impulses which reach the cord are carried by them. Interoceptive fibers from the viscera, proprioceptive fibers from the muscles, tendons and joints, as well as exteroceptive fibers from the skin are included in these roots; and among the latter group are several subvarieties, mediating the afferent impulses out of which the sensations of touch, heat, cold, and pain are elaborated."[1]

"The extreme length which the process of one of these neurons may attain will be appreciated if one considers that a single nerve cell located in a lumbosacral ganglion may not only send a peripheral process to one of the toes but its central branch, after entering the spinal cord, may bifurcate into two branches, one of which ascends the whole length of the spinal cord. In this case, the total length of the neuron would equal approximately the distance from toe to nape of neck."[2]

"The descending branches pass through many segments of the spinal cord, so that the branches from the sensory nerves of the cervical plexus can be found in the sacral segments."[3]

Because of these and other still unknown complexities, smooth, normal function of nerve structures is possible only when their normal anatomohistologic integrity allows each nerve structure to perform the special duty assigned to it by evolution, thus assuring a definite physiologic pattern of coordinated, cooperative, interdependent functional activities. How is this pattern distorted in cases suffering from intractable pain? In peripheral sensory neurons, beside the cell bodies, three definite portions can be distinguished each with a specific limited function: (1) the receptors for the perception of stimuli; (2) the fibers for the transmission of nerve impulses; (3) the means of synaptic connection with other neurons. In the central sensory neurons there are no receptors; their nerve fibers end on both sides with structures for interneuronic connections through synapses. It is essential to understand and consider the capital importance of the following physiologic axioms which establish clearly the essential difference between the functional behavior of normal neurons and those pathologically altered in order to appreciate the unique effectiveness of spinal ganglia block in controlling modalities of pain considered up to now intractable:

(1) The only portions of the nerve structures intended to be stimulated are the receptors. In order to attain this aim evolution has devised well known efficient means which simultaneously facilitate stimulation of the receptors and prevent stimulation of any other portion of the nerve structures. It is imperative that it be so, because the function of the sensorium is informative and the receptors are only and very complex organs of different histologic structure developed by evolution for the sole purpose of furnishing specific information. Consequently stimulation of any other portion of the nerve structures would cause confusion, to say the least, and the normal pattern of nerve function can be maintained only if the normal cycle of impulses starts exclusively from the informative organs, namely, the receptors, runs to the centers and from the centers to the effectors. It is axiomatic knowledge that exclusive one way direction, centripetal for afferent impulses and centrifugal for motor impulses, is essential to the normal function of nerve structures. (2) Direct stimulation of all varieties of nerve fibers starts impulses which run in both

directions along the fibers, i.e., centripetally and centrifugally. (3) Evolution has assured the one direction of impulses by placing both the receptors and the effectors at the extreme periphery, by adequate insulation of nerve fibers singly and in group and by the polarity of the synapses, thus forcing the spreading of the nerve impulses in certain predetermined directions and to predetermined structures. (4) Nerve current, analogously to electric current, escapes along the lines of minor resistance when the insulation of its conductors, i.e., nerve fibers, becomes inadequate. (5) The factors which assure adequate essential insulation of nerve structures are: (1) proper media; (2) normal intercellular tension; (3) biophysical means, such as neurilemma and myelin sheaths.

Although only the modalities of intractable pain which are caused by malignancies are hereby discussed, evidently, except for secondary peculiarities, the same considerations apply to all modalities of chronic pain. In malignancies, especially after ineffectual deep therapy, the intercellular tension becomes abnormal, often being substituted by true compression, the media are always profoundly altered and the biophysical means of insulation are either totally destroyed or seriously damaged. Cross currents resulting in abnormal cross stimulation of neighboring nerve fibers follow inadequacies of insulation. Nerve short circuits physically and dysfunctionally analogous to electric short circuits result between neighboring fibers when their insulation becomes inadequate causing disconcerting complex abnormal interactions between the various afferent and efferent neurons. Moreover, stimulation and the generation of impulses does not remain limited to the receptors; damaged afferent and efferent fibers turn into linear receptors which are easily stimulated directly and through abnormal cross currents from neighboring fibers. Stimulation of the highly irritable nerve fibers perverts, distorts and completely disrupts their normal function, which is limited to one way specifically predetermined conductivity. Volleys of abnormal impulses chaotically jump to and from afferent and efferent, fast and slow cerebrospinal and autonomic fibers and, running antidromically, disrupt synapses by butting against them and in inextricable turmoil riotously bombard centers, effectors and receptors to which they were not destined.

Proper consideration of the Wallerian law explains clearly why the volleys of these abnormal impulses, which cause the well known simultaneous sensory, motor, circulatory and secretory dysfunctions observed in cases of malignancies with unbearable and intractable pain, can evidently be stopped only by blocking the spinal ganglia with appropriate anesthetodevitalizing solutions. All the pathologic connections created by the malignancy between any and all portions of the peripheral afferent sensory neurons of the focus doloris and any and all other nerve structures must be absolutely thoroughly destroyed in order to prevent any painful impulse generated therefrom being somehow shortcircuited to the centers. The importance of doing so becomes self-evident if we consider the well known fact that thorough and completely done destructions of nerve structures either by alcohol or surgery have often failed not only to control the pain permanently but, beside unbearable functional disturbances, have also been the direct cause of most distressing additional new modalities of pain, as exemplified by the unbearable girdle pain which appears after chordotomy. It is self-evident that these cases prove that all the pathologic connections caused by pathologically shortcircuited nerve structures could not be destroyed by the procedures adopted. Obviously devitalization of the vital trophic center of the whole neuron, i.e., the cell body located in the spinal ganglia will automatically, according to the Wallerian law, devitalize the whole neuron in its entirety together with all its normal and pathologic con-

nections, whether the neuron is a short one or its processes extend from the medulla to the tip of the toes. Monsieur de La Palice would say that devitalized receptors cannot be stimulated and generate impulses; devitalized fibers cannot transmit impulses nor be directly stimulated; devitalized interneuronic connecting organs cannot make synaptic connections. Stated in different words, the fact remains that devitalized neurons cannot under any circumstances generate nor transmit impulses painful or otherwise. Consequently, if our fundamental axiomatic anatomohistologic and physiologic knowledge of nerve structures is correct, it can be logically asserted that blocking of the spinal ganglia containing the cell bodies of the neurons innervating the focus doloris with appropriate devitalizing solutions will positively control the modalities of pain, up to now called intractable, because no impulse can either originate or be transmitted from the loci, the neurons of which have been devitalized in their entirety.

CLINICAL ASPECTS OF SPINAL GANGLIA BLOCK

The spinal ganglia can be easily and effectively blocked through the peridural route. It is fundamentally important to establish immediately that the type of block variously designated as peridural or epidural, caudal anesthesia or block and spinal ganglia block have in common only the route chosen to effect them, *nothing else*. Their aims and the mechanism of their effects and technic are radically different. It suffices to state that with peridural anesthesia, efferent and afferent structures are simultaneously and equally blocked efficiently because the structures actually blocked are the first portions of the mixed spinal nerve which lie outside of the peridural space. As a matter of fact, peridural anesthesia or block is a misnomer because the blocking effects take place within and beyond the foramina conjugata through which most of the anesthetic solution is compelled to ooze out of the peridural space. This statement is not meant as a disparagement; it is made solely in order to clear the fundamental differences between spinal ganglia block and the misnamed peridural block, which is actually the ideal method of obtaining the absolutely perfect and most effective paravertebral block. As a matter of fact, no other artifice but the technic of peridural anesthesia by which the anesthetic oozes out of the foramina conjugata could possibly so thoroughly surround and bathe without waste and, consequently, so ideally block the mixed spinal nerves at their origin.

Spinal ganglia block means exactly a block limited to the spinal ganglia which is proven by the fact that patients anesthetized, for instance from the waist down, can freely walk, their walk resembling the walk of tabetics. The solution injected in the peridural space with the aim of blocking solely the spinal ganglia must remain wholly and exclusively in the posterior aspect of the peridural space and constitute a reservoir of devitalizing material, the action of which is slow but lasts a considerably long time. The solution must be concentrated and its amount must be absolutely limited to that which will saturate only the posterior aspect of the peridural space. Weak, abundant solutions cannot produce spinal ganglia block.

Clinical considerations on spinal ganglia block used in over 2,000 surgical cases in the last ten years are completely bypassed, except to mention that the addition of alcohol to the anesthetic solution, which turns it into an anestheto-devitalizing solution, is the only variance when spinal block is used for the control of chronic pain. The addition of the alcohol to the basic surgical 10 per cent solution of novocaine gives it devitalizing characteristics absent in the plain novocaine solution. The amount of alcohol added varies from 5 to 25 per cent, according to the degree of devitalization desired. The following considerations have guided the

determination of the amount of alcohol to be added to the basic 10 per cent novocaine solution. It is essential to avoid the caustic action of pure and high dilutions of alcohol in the peridural space. It is not necessary to destroy the spinal ganglia in order to obtain pain control. It is practically always possible to control even the most severe pain without penalizing the patient with total loss of sensation. This statement requires some explanation. It is generally admitted that the smaller naked fibers are responsible for pain. The cell bodies of the smaller naked fibers are proportionally also smaller and more easily affected by the anestheto-devitalizing solution than the cell bodies of the myelinated fibers which mediate fundamental sensations most worthy of preservation. The greater the amount of alcohol added to the basic 10 per cent novocaine solution the more extensive is the devitalization of the cell bodies. In other words, the larger cell bodies require a larger amount of alcohol than the smaller to be devitalized. Consequently, it is scientifically logical and clinically most advantageous to limit the devitalization to the smaller cell bodies and preserve the larger ones when possible by limiting the amount of alcohol to the minimum required for the control of pain.

Evidently the anatomo-histologic and clinical factors concerned with the effective control of intractable pain are too many and too complex to be fully discussed in a short paper, but the following basic outline of conduct will aid the physician to deal with his patients in the most humane, scientific and effective manner. The basic principle is that preservation of as much normal sensation as possible is of the utmost importance. Consequently, because of the impossibility of determining a priori how the spinal ganglia of each patient will respond to the devitalizing process and of the fact that spinal ganglia block is neither a difficult nor an expensive procedure, it is preferable to repeat the block than to use the larger proportions of alcohol. The average effective amount of alcohol has been found to be from 5 to 15 per cent. Permanent control of pain, with preservation of normal sensations, has been obtained in some cases either with a single block or with blocks repeated at various intervals and the addition of only 5 per cent alcohol to the basic 10 per cent novocaine solution. These represent the absolutely ideal results which, however, unfortunately cannot be expected in all patients and which are not obtainable in those whose psyche has been deranged to the point that even the slightest ordinary pain and simply the fear of pain has become intolerable and who confuse pain with other miseries inherent in malignancies. In these cases it is advisable to use immediately the higher proportions of alcohol, namely, 15 per cent and repeat the block with higher percentages, if necessary; or when conditions are desperate and there is nothing to preserve, to use the highest percentages directly, namely, 20 or 25 per cent. The best guide on the optimum percentage of alcohol for each patient is the amount of cooperation that he or she offers. With the most cooperative patients the treatment should be started with the basic 10 per cent novocaine solution containing 5 per cent alcohol, and the block repeated either with the same percentage of alcohol or an increased percentage according to the devitalizing effects produced by the previous percentage, taking notice of the fact that the devitalizing effects and consequent period of pain relief of each successive block lasts much longer than those of the preceding blocks. Thus, while an intelligent, cooperative patient may be ideally treated with a series of blocks done with the 5 per cent alcohol percentage with consequent preservation of normal or quasi normal sensation, the very uncooperative, psychically upset patient must be treated progressively less ideally with a single or a couple of blocks and consequent more or less marked loss of sensation.

TECHNIC

The technic of spinal ganglia block is *per se* not more difficult than an ordinary spinal tap. However, its efficiency and absolute safety depend solely on whether or not all the safety measures are observed which have proven 100 per cent reliable in over 2,000 cases, some of whom presented very serious technical and clinical difficulties.

The anestheto-devitalizing solution must diffuse along the posterior aspect of the peridural space by saturation of the loose connective tissue located therein. In order to prevent its spreading to the anterior aspect and oozing out of the peridural space through the foramina conjugata, the injection must be done with just enough pressure on the plunger to have the fluid drop out of the needle. A practical way to learn to inject the solution at the proper *slowness* is to separate the syringe from the needle left *in situ* after each cc. injected. Not a drop of solution will drop from the needle if the injection has been done with the proper slowness, which is facilitated by the use of the finest spinal needles. The disappearing drop phenomenon will give absolute certainty that the point of the needle is in the peridural space and can be produced thus: The spinal needle is introduced into the tissues while 1 per cent solution of novocaine is gently injected into them. When according to the thickness of the area the needle has been advanced toward the spine 3 to 5 cm. the syringe is detached and the needle is left *in situ*. The physician verifies if a drop of solution is hanging on the shank of the needle; if not, he just puts a drop there. He then very slowly advances the needle toward the spine. If he proceeds slowly, he will see that the drop hanging from the shank of the needle is all of a sudden sucked in. This means that the point of the needle is within the peridural space, and thus by maintaining the needle *in situ* there cannot be any danger of introducing the solution into the subdural space.

The sitting position is the one to be preferred during the injection, after which the patient is immediately placed comfortably on his back for several hours. Anesthesia appears after ten to twenty minutes. Each cc. of solution blocks about two metameres.

Because of the overlapping of peripheral nerve fibers originating from adjacent roots, it is advisable always to block a couple of pairs of ganglia above and below the fibers which innervate the focus doloris.

It is understandable that in a class of patients such as those who suffer from various modalities of intractable pain, technical and clinical difficulties will be met. Obviously the most serious is the failure to detect the peridural space and this unfortunately often occurs in patients who need the relief most, namely, those who suffer from inoperable malignancies of pelvic organs. In these cases age and deep therapy have caused deteriorations of the peridural space which prevent the production of the disappearing drop phenomenon and render any other means of ascertaining whether the point of the needle is or is not in the peridural space very aleatory. I have been forced to adopt procedures which made spinal ganglia block very difficult and not always ideal, until recently I discovered that even in the most desperate cases the spinal ganglia up to the fourth and fifth dorsal pairs could be ideally and without difficulty blocked through the sacral route. To do so, after the needle is introduced through the sacral hiatus to the height of the second sacral vertebra, the patient is turned on the back, placed in the Trendelenburg position and the injection done with the same precautions required for block done with the patient in the sitting position. In fact the results have been so satisfactory that I consider the sacral route preferable in the aged and in those who for any reason cannot be placed comfortably in the sitting position. When the sacral route is chosen, the small detail which I use routinely in all spinals of

nicking the skin with a carbolized scalpel[4] at the point where the needle is inserted should be adopted in order to prevent any possibility of infection of the peridural space. When the peridural space cannot be detected in the upper spine, the block may be attempted safely if the following precautions are faithfully observed: In these cases after the spinal needle has reached the subdural space, as evidenced by the appearance of the spinal fluid, it is withdrawn slowly until the spinal fluid ceases to drop out, which indicates that the needle is in the peridural space. An empty syringe is connected with the needle left *in situ* and the plunger is retracted; failure to aspirate spinal fluid is an indication that the point of the needle is not within the dura. The syringe containing the anesthetodevitalizing solution is then substituted for the empty syringe and not more than 2 cc. are injected. If no anesthesia appears within five minutes, it means that the solution has not been injected within the dura and it is safe to proceed and inject the rest. When unilateral block is desired, the patient is placed during the injection and is kept for at least a couple of hours on the flank, with the body slightly leaning toward the back, so that by gravitation the solution is injected and remains on the side of the posterior peridural space where the ganglia to be blocked are located.

CONCLUSIONS

In the cases of so-called intractable pain when pain has often ceased to be a symptom and has become a true most serious disease, neither the individual nor his nervous system are normal. The pathologic conditions which are the direct cause of the severe chronic pain have disrupted and continue to disrupt not only the psyche but also the normal pattern of sensations physically, because they have disrupted the normal anatomo-histologic pattern of nervous structures and of their media. Nerve structures of the focus doloris have become shortcircuited to distant nerve structures especially through the nerva vasorum and the sympathetic fibers scattered in the tissues which continue to send algogenic impulses to the centers, unless and until all the peripheral afferent neurons are completely devitalized in their entirety and thus cease to have any pathologic connections with other near and distant nerve structures. Consequently we can logically conclude that a combination of anatomo-histologic, physiologic, pharmaceutical and clinical factors make the spinal ganglia a unique locus ideally suited for a uniquely effective safe control of all modalities of pain, including those up to now considered intractable and originating in organs the nerve fibers of which have their cell bodies in the spinal ganglia. This means that spinal ganglia block will effectively and safely control pain originating in all the organs from the neck to the toes. In justice to patients it would seem reasonable to suggest that before surgery is resorted to spinal ganglia block should be given a thorough trial.

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COMPLETE LIGATION OF THE ABDOMINAL AORTA FOR ANEURYSM BY THE SPIRAL METHOD*

A CASE CONTROLLED BY AORTOGRAPHY

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ONE hundred thirty-one years have passed since Sir Astley Cooper[1] performed the first ligation of the abdominal aorta for aneurysm and the problem continues to fascinate surgeons. His patient, a thirty-eight year old porter, was operated upon April 9, 1817, and survived for three days. The report of the autopsy does not give the cause of death. In 1829 James[2] performed the second reported ligation on the aorta of a man forty-four years of age. His patient lived for only four hours. In 1834 the third ligation, by Murray[3] was done on a man thirty-three years old who lived only twenty-three hours. The autopsy proved that the aneurysmatic sac was gangrenous. The fourth ligation of the abdominal aorta was performed by Borges Monteiro[4,5] in Brazil in 1842. He was the first to establish the possibility of completing this operation without causing gangrene of the inferior limbs since his patient lived eleven days. Following these four cases which belong to the pre-anesthetic days of surgery, ten more ligations were done during the nineteenth century by South,[6] MacGuire,[7] Stokes,[8] Watson,[9] Czerny,[10,11] Milton,[12] Keen,[13] Körte,[14] and Tillaux.[15]

In 1856 South performed the first ligation of the aorta under anesthesia. In 1868 MacGuire also attempted the operation, but it resulted in complete failure because the patient showed paralysis of the inferior limbs and incontinence of urine after the operation, surviving eleven and one-half hours. Autopsy showed that the left ureter also had been included in the ligature. In 1869 Stokes used a special technic to obtain a temporary ligation. His report reads as follows: "A silk ligature was applied, the ends of which were attached to a Porter artery-compressor, the object being to apply a temporary ligature." After the operation the patient showed paralysis of the inferior limbs and died of shock thirteen hours later. In 1869 Watson published a report of his own operation. He gave reference neither to the date of the operation nor to the personal data of the patient, but he said that nine weeks before the aortic ligation the external iliac artery had been ligated. This patient lived sixty-five hours, developing gangrene of both legs forty-eight hours after the operation.

The two cases of Czerny were the first in which ligations of the abdominal aortas were made in patients without aneurysms. The first patient operated upon in 1870 was a twenty-seven year old soldier who had received a bullet wound in the iliac artery. He died twenty-seven hours after ligation of the aorta which was mistaken for the common iliac; death was caused by sepsis and hemorrhage. In 1879 Czerny was obliged after nephrectomy to perform a ligation between the two renal arteries because of uncontrollable hemorrhage. The patient lived only ten hours after the operation. In 1890, Milton performed a ligation with silk in a patient with a ruptured aneurysm. The patient, a man forty-five years old, died of anemia and shock after twenty-four hours. In 1899 Körte ligated the abdominal aorta of a man twenty-eight years old who suffered a rupture of the sac after ligation of

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the common iliac which had been done thirty-six days before. His patient died of hemorrhage and shock one hour after the operation.

During the nineteenth century the patient who lived the longest (forty-eight days) was operated upon by Keen in 1899. He was a fifty-two year old man. The ligation was made with silk below the diaphragm but eight days later the ligature gave way which improved the blood supply of the limbs. The aneurysmal bruit reappeared, and the abdominal distention was evident again. The patient died of hemorrhage of the aorta at the level of the ligature. In 1900 Tillaux operated upon a fifty-six year old man with a ruptured iliac aneurysm. He, like Czerny, performed an aortic ligation by mistake thinking he had the common iliac; the patient survived thirty-nine days. Although Tillaux gave no details concerning the death, it would seem that the cause was hemorrhage due to failure of the ligature.

As a valuable contribution to the problem of ligation of the abdominal aorta during the last century one must consider the experimental work of Kast[16] which was published in 1880. He presented interesting diagrams showing the collateral blood supply obtained after ligation of the aorta in animals. He arrived at the conclusion that animals like guinea pigs, which have a weak abdominal wall, are subject to paralysis of the posterior limbs and of the sphincters because the possibilities of collateral circulation are very limited. In animals with a thick abdominal wall, e.g., dogs and cats the results are good. He concluded also that the heart does not suffer from a ligation of the aorta. Of the fourteen ligations performed upon human beings during the last century the only favorable knowledge which we have gained is that ligation is possible in a great many cases from the point of view of blood supply.

At the beginning of the twentieth century, in spite of the progress made in the art of surgery, few surgeons cared to attempt ligation of the aorta due to the disastrous results previously described. Therefore, until 1920 only seven ligations were performed, four of them by the same surgeon. In that period the greatest preoccupation was with trying new types of ligatures because of the complete failure of the use of thread during the previous period. In 1901 Morris[17] operated upon a colored woman twenty-four years old. The aneurysm extended from the coeliac trunk to the mesenteric vessels. He performed a temporary ligation distal to the aneurysm using a rubber tube held with a clamp. He observed sphincter incontinence during the first hours and the ligature was taken out twenty-seven hours after the operation. The patient died three days after the operation from intestinal gangrene caused by the presence of the clamp. Use of the rubber tube was again tried by Scott[18] in 1905 in a patient with a bullet wound. The patient died one hour after the operation. Halsted,[19] in an attempt to avoid infection and at the same time to effect a gradual occlusion of the aorta, inaugurated the use of an aluminum band. However, he was not successful in the operations which he performed in 1906, 1908, 1909 and 1911. Three of his patients on whom he used this band died from hemorrhage twelve hours, eighteen days and six weeks, respectively, after the operation. The fourth patient, on whom he used cotton tape hoping to use the aluminum band later, died of infection twelve hours after the operation. In 1917 Heuer[20] had the same unfortunate result from use of the aluminum band because the aorta ruptured at the level of ligation. His patient survived thirty-nine days. This first period of the twentieth century shows us that the rubber tubes and metallic bands are inadequate for ligation of the aorta.

In 1920 Vaughan[21,22] inaugurated a new period in the history of abdominal aorta ligation, his patient surviving for a period of two years and one month which was a

compensatory result. Unfortunately, however, the patient was not cured of the aneurysm. The patient was a thirty-nine year old man who was suffering from an aneurysm of the abdominal aorta which reached the level of the superior mesenteric artery. Vaughan used cotton tape and performed a distal ligation, but he obtained only partial occlusion of the vessel as verified by the autopsy findings. The aneurysm had increased in size without breaking.

Reid[23,24] had a chance to perform two ligations of the aorta. The first in 1921 was unfavorable because the aneurysm was located at the height of the inferior mesenteric artery. He performed first a partial ligation of the aorta between the inferior mesenteric artery and the renal arteries using cotton tape. Four and one-half months later, in a second operation in which he performed a new ligation upon the coeliac trunk, the patient died of a rupture of the aneurysm. In 1928, Reid performed a ligation of the thoracic aorta in a patient with an aortic aneurysm at the level of the coeliac trunk. He inserted a fascial plug with fixation by silk sutures. This patient, a thirty-five year old woman, died twelve hours after the operation from a secondary hemorrhage of an intercostal vessel.

Watts[25] also performed the operation twice within six months. In February, 1923 using cotton tape he performed a ligation above the renal arteries in a patient in whom the aneurysm extended from the bifurcation to the level of the superior mesenteric artery. However, this patient developed postoperative anuria and died twenty-two hours after the operation. Three hours before his death he was operated upon again to ease the ligature. In September, 1923 Watts attempted the operation again with the use of cotton tape. The patient was a sixty year old woman. The aorta was partially ligated with cotton tape immediately below the superior mesenteric artery. The patient survived three and one-half years, dying of a rupture of the aneurysm. In spite of this eventual outcome the result obtained by Watts represents a great improvement.

In April, 1923 Matas[26,27] operated upon a colored woman twenty-eight years old. He performed a ligation of the abdominal aorta with two cotton tape ligatures. The tapes were placed in juxtaposition, one above the other. This patient lived for one year and five months and was the first patient who died of a cause not related either to the aneurysm or to the ligature. The report of Matas was first given in 1925 and later in 1940. The autopsy proved that the cause of death was a tuberculous pulmonary hemorrhage. The aneurysmal sac was almost obliterated, but the occlusion of the aorta was not complete due to the yielding of the ligatures which were well tolerated by the tissues and caused no damage to the artery. This case of Matas showed the first real success obtained from ligation of the abdominal aorta.

In 1926 Brooks[28] reported one of the more instructive cases of ligation of the abdominal aorta which was performed in 1925. The patient was a fifty-nine year old colored man, who showed a large aneurysm of the terminal aorta below the inferior mesenteric artery. Brooks attempted an aneurysmectomy but this had to be abandoned because of a rupture of the sac followed by intensive hemorrhage. He was obliged to limit his operation, performing the ligation of the aorta below the inferior mesenteric artery. He used fascia lata above and silk thread below. The patient died three months later from intestinal occlusion. Autopsy proved that the silk thread had partially cut the wall of the vessel and that the strip of fascia lata had yielded. The aneurysm had been very large and had caused erosion of the inferior lumbar and the superior sacral vertebrae. According to Brooks, use of the fascia lata above and the silk below was based on the idea of reducing the blood pressure on the silk. Complete occlusion of the aorta and obliteration of

the sac must be attributed to this special technic.

In 1929 Andrus[29] was the first to divide the aorta between two ligatures made with cotton tape. The aneurysm was situated immediately below the diaphragm, the vessel being cut in the thorax. His patient lived only one and one-half hours, dying from shock. Also in 1929 La Roque[30] performed partial ligation of the aorta with umbilical tape and heavy silk upon a woman thirty years old. In his paper he reported that the patient was in good condition after fourteen months, showing reduction of the aneurysm which was localized in the right common iliac artery.

The contribution of Bigger[31] to surgical treatment of the aortic aneurysm is of exceptional value. He operated upon two patients. In 1938 he performed a ligation with fascia lata above the inferior mesenteric artery in a man fifty-four years old. After twelve hours "the right leg was becoming shrivelled in appearance and showed areas of discoloration over the dependent portions; the right femoral vein was ligated with the hope that this might improve the circulatory balance in that leg." The patient developed left-sided heart failure with pulmonary edema and died eighteen hours after ligation of the aorta. Autopsy showed that the aneurysmal sac was filled by fresh clot, the lumen of the external iliac artery was occluded by arteriosclerotic changes and a fresh thrombus filled the hypogastric artery. Bigger explained the acute circulatory deficiency as follows: "Since the autopsy showed long-standing occlusion of the external iliac artery, the acute circulatory deficiency following aortic occlusion is adequately explained by the formation of a clot in the hypogastric artery and its major branches, because, under the circumstances, this vessel was an essential collateral channel." In relation to the failure of the left side of the heart he stated that, "the occlusion of the aorta per se probably played an unimportant part in the outcome, and abdominal exploration without aortic occlusion might well have led to the same result." The author partially agrees with him and calls attention to the difficulty in establishing a prognosis in patients with ligation of the abdominal aorta. The second patient operated upon by Bigger was the first success of the aortic aneurysmorrhaphy according to the technic of Matas. The latter had been attempted four times before Bigger by Lozano,[32] Munro,[33] Crile[34] and Kümmel,[35] respectively, but had always resulted in failure. Bigger operated upon his patient, a twenty-five year old man who had a traumatic aneurysm of the terminal aorta, on September 14, 1938, performing a ligation with fascia lata. He observed neurologic changes as a result of temporary anemia of the peripheral nerves of the lower extremities but the patient reacted quite well. On January 10th he performed an aneurysmorrhaphy but the aneurysmal sac was reduced to about one-half its previous size and was not pulsating. This patient was alive and apparently well after sixteen months.

Another good result in a sixty-one year old man was obtained in 1939 by Elkin[36] in a ligation partially occluding the aorta with two cotton tapes. Following operation, the patient complained only of some coldness of the legs but this disappeared in two days. Eleven months after operation the mass was considerably smaller but it showed slight pulsation and a definite systolic bruit could be heard over it. Complete occlusion had not been accomplished.

Morton and Scott[37] in 1942 performed a ligation upon a man who already had undergone a previous abdominal exploration. The operation was done after rupture of the sac which had been followed by hematomas collected in the retroperitoneal space. Two cotton tapes were used for the ligation. The patient, a fifty-two year old man, developed gangrene of the left leg which necessitated amputation ten days after ligation of the aorta. After seven

months this patient died of an acute abdominal condition. Autopsy showed a sacular secondary aneurysm immediately above the ligature and a fistula connecting the aorta with the jejunum. In the same layers of ribbon gut. The patient developed Cheyne-Stokes respiration and died twenty-four hours later. Finally in August, 1943 the author performed the thirty-sixth ligation of the abdominal aorta upon

TABLE 1
CASES IN WHICH IMPROVEMENT WAS OBTAINED

Type of Ligation	Surgeon	Year	Material Used	End Results
Distal ligation	Watts	1923	cotton tape	Survival 3½ years; death due to ruptured aneurysm
Proximal partial ligation	Vaughan	1920	cotton tape	Survival 2 years and one month; aneurysm not cured
	Matas	1923	cotton tape	Survival 1 year and 5 months; death due to another cause; aneurysmae sac practically closed
	Elkin	1939	cotton tape	Survival up to publication (11 months); reduction in size of the aneurysm which continues pulsating
	La Roque	1929	umbilical tape and heavy silk	Survival up to publication (14 months); marked improvement
Proximal total ligation	Brooks	1925	fascia lata and silk	Survival 3 months; death due to intestinal occlusion; aneurysm cured; aorta occluded
	Prudente	1943	spiral of fascia lata	Survival 3½ years to date of this writing; aneurysm clinically cured; aorta occluded
Proximal total ligation and aneurysmorraphy.	Bigger	1938	fascia lata	Survival 16 months up to publication; aneurysm clinically cured; aorta occluded

year Monahan[38] used the method advised by Owings[39] who, with the use of rubber bandage, made an experimental occlusion of the thoracic aorta in dogs. Monahan performed the operation in three stages. On March 20, 1942, he made a three-fourths partial occlusion with rubber bandage. In a second stage on April 11, 1942, he totally occluded the aorta again using rubber bandage. Finally on May 15, 1942, he completed the ligation and section of both common iliac arteries with silk. This patient was discharged on June 2, 1942, but died from hematemesis. Autopsy showed a perforation of the aorta next to the superior rubber ligature, a sacular aneurysm and an aorticoduodenal fistula. The edge of the rubber ring probably destroyed the arterial wall.

In March, 1943 Ormond, Harkins and Smith[40] operated upon a patient with a ruptured aneurysm of the abdominal aorta, performing the ligation with two the patient whose case is reported in this paper.

Until today improvements were obtained in only eight patients of the fifteen operated upon after 1920. (Table 1.) Among this group in only three (Brooks, Bigger and Prudente) was total occlusion of the aorta obtained. Fascia lata was used in these three patients with the addition of silk in the first, aneurysmorrhaphy in the second and only fascia lata by the spiral method in the third. Cotton tape was most useful but until now it does not effect total ligation in a human being.

CASE REPORT

The patient, A. M. N., a white man forty-four years old, was admitted to the Santa Cruz Hospital, São Paulo, Brazil on August 29, 1943. He complained of a tumor in the abdomen and extreme pain in the right inferior limb.

Past history revealed that he had acquired a syphilitic ulcer twenty-two years before and had undergone treatment for the ulcer until it

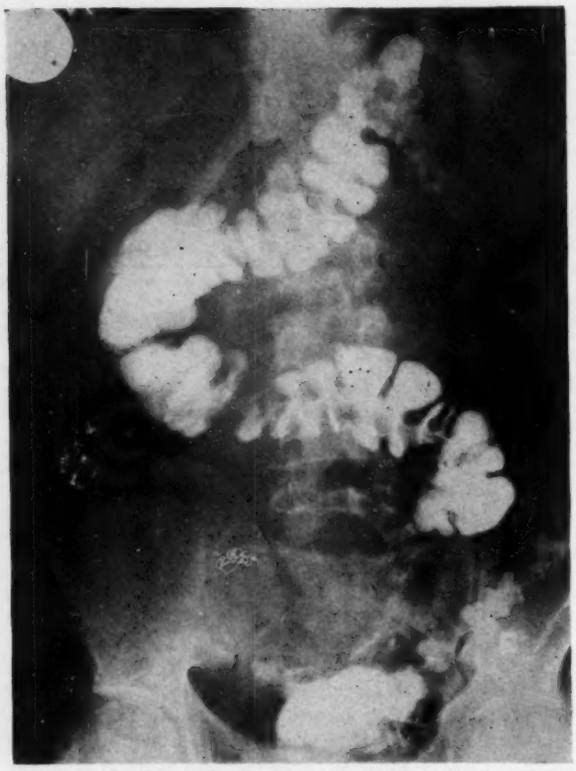


FIG. 1. Radiograph showing deviation of the right colon and cecum before operation.

FIG. 2. Photograph of the scar showing the incision line.

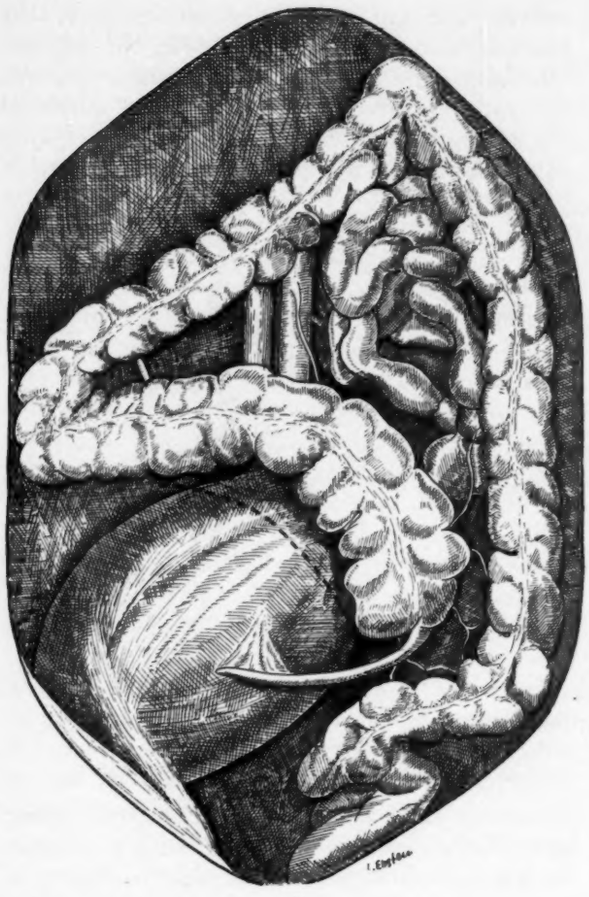
was healed. However, he received no treatment for his basic condition.

The present history disclosed that on April 18, 1943, while resting, he felt an acute pain in the posterior side of the right leg. Some relief was obtained from a hot bath. The next day the pain reappeared and continued intermittently. On May 15 the pain started in the abdomen as well and he observed a soft excrescence in the lower abdomen. On May 20th the pain extended to the right gluteal region and from this day on it was impossible for him to walk; he was obliged to lie down with his thighs flexed on his abdomen. From the time that the disease started he reported complete "impotentia coeundi." On August 8th the pain became so intense that morphine was employed; this condition persisted until August 26th when morphine was inefficient and he agreed to enter the hospital. On August 27th he was sent to the Hospital do Braz where an x-ray with barium was made. During the period of his illness he lost about 28 pounds, his actual weight being 108 pounds at this time. On August 29th he was put under the author's care at the Hospital Santa Cruz.

Physical examination revealed that the patient was a white male, very weak and emaciated with his facies contracted with pain. He was obliged to remain in the dorsal recumbent position with his thighs flexed on his abdomen due to the spasm of the iliopsoas muscles. His temperature was 36.6°C., pulse, 72; respiration, 26 and blood pressure 120/70. The only important findings were those presented by the abdomen and lower extremities. Upon inspection one could see a pulsating mass in the lower abdomen. The mass measured about 5 inches from right to left. Its upper margin was at the level of the umbilicus and the inferior limit could not be found because the pulsating mass was hidden by the inguinal rigid elements. Thrill was audible along the whole extension of the tumor, its pulsation synchronizing with the heart beat. All arteries of the lower extremities were pulsating well. The previous barium enema showed a deviation of the right colon and cecum to the medial part. (Fig. 1.) Blood examinations were as follows: coagulation time, 10 minutes; bleeding time, 2 minutes; red blood count, 3,800,000; hemoglobin, 70 per cent; white blood count, 7,000; Wassermann and Kahn reactions, negative. Urine analysis was negative.

Diagnosis: Aneurysm of the abdominal aorta and the right common iliac artery.

Operation was performed on August 30, 1943. Spinal anesthesia with 150 mg. of scurocain followed by a veritol injection was administered. The thighs could be extended; the spasm of the iliopsoas muscles disappeared. The abdominal wall was incised at the medial line 2 inches above and 3 inches below the



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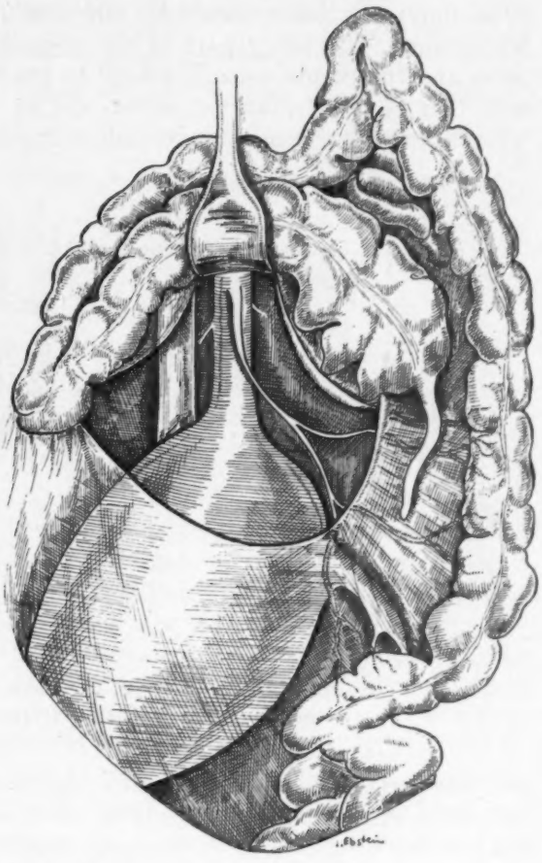

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FIG. 3. The appearance of the aneurysm after laparotomy. The dotted line shows the incision line of the posterior peritoneum.

FIG. 4. The appearance of the vessels after dissection of the posterior peritoneum.

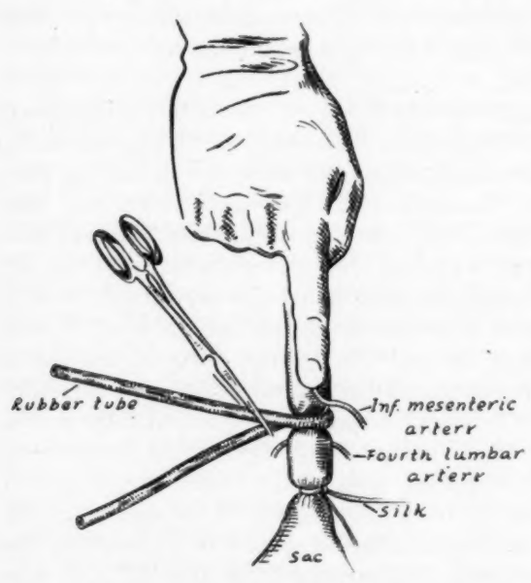

FIG. 5. First stage of spiral ligation, temporary occlusion of the aorta with a rubber tube; temporary smashing with silk.

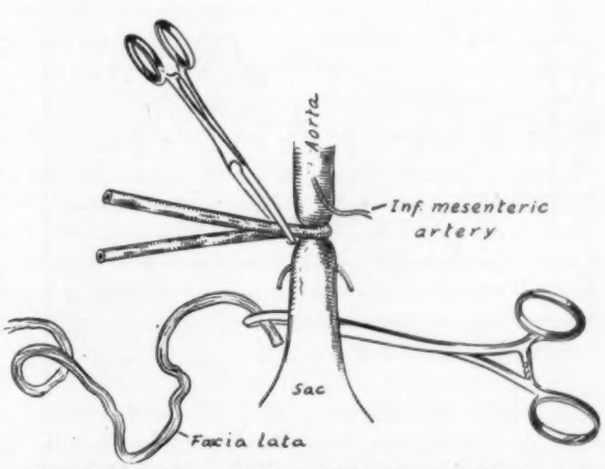

FIG. 6. Second stage of spiral ligation; the silk thread was removed. The fascia lata is passed behind the aorta.

umbilicus. (Fig. 2.) The aneurysm was seen immediately; it was covered by the posterior peritoneum. The lower part of the ascending colon and the cecum were displaced to the left side. (Fig. 3.) The peritoneum was cut at the external edge of the cecum and right colon and was dissected sufficiently to reach the aorta above the aneurysm. (Fig. 4.) The aneurysm was the size of a two year old child's head. It began at the bifurcation of the aorta and involved the entire right common iliac, the external iliac and penetrated under the inguinal elements. The aorta above the aneurysm was separated from the vena cava and encircled for a longitudinal extension of about 2 inches up to the exit of the inferior mesenteric artery.

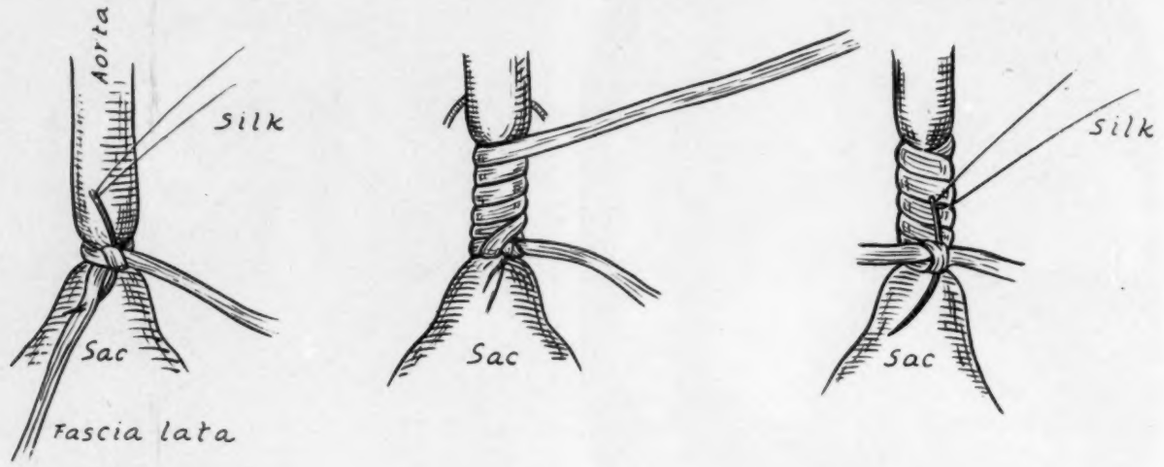

FIG. 7. FIG. 8. FIG. 9.

FIG. 7. Third stage of spiral ligation, the fascia lata is knotted and fixed by silk suture.
Fig. 8. Fourth stage of spiral ligation, first layer of fascia lata spiral is performed.
FIG. 9. Fifth stage of spiral ligation, second layer of fascia lata spiral is performed; ligation is complete.

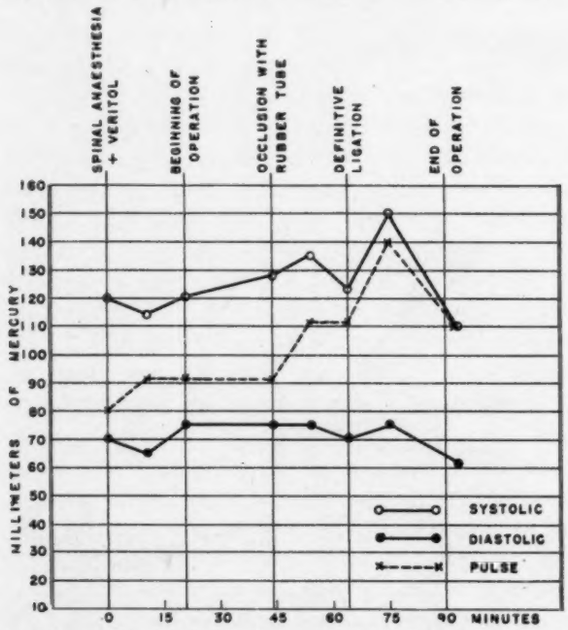

FIG 10. Systolic and diastolic blood pressure and pulse during the operation. The rise in blood pressure corresponds to compression of the aorta with rubber tube and to the definitive ligation of the vessel.

A rubber tube was passed around the upper part of the aorta and clamped with forceps in such a way as to obtain complete occlusion of the vessel. In order to permit such a procedure the assistant pressed the aorta against the spine with his finger in a position parallel to the vessel. (Fig. 5.) Consequently, the pulsations of the sac disappeared. After that test the rubber tube was opened and left in the same place. A strip of fascia lata about 30 cm. in length and about 1.5 cm. in width was removed from the right thigh. After occluding the aorta again with the rubber tube it was easy to perform the definitive ligation. The technic employed (Figs. 3 to 9) was as follows: A thick silk thread was tied around the aorta to smash the endothelium and it was removed afterward. One of the extremities of the fascia strip was passed around the lowest part of the aorta immediately above the aneurysm and was tied with a surgical knot; this was fixed by a silk suture. The free extremity of the fascia was then wrapped around the vessel four times in order to obtain a spiral. Upon reaching the upper part the fascia strip was directed to the lower part thus covering the first layer. It was tied to the other extremity which remained at the lower part. Again a silk suture was used to

fix the fascia. With that technic, a closing ring around the aorta of about 1 inch in height resulted. When the operation started, blood pressure was 120/70; it rose to 150/78 immediately following occlusion of the aorta, at which time the pulse was 140 and respiration 42. At the end of the operation the duration of which was one hour and ten minutes the blood pressure was 110/60. (Fig. 10.)

On the first postoperative evening the blood pressure was 130/70, pulse, 100 and temperature 36.8°c. The patient's general condition was satisfactory. No pulsations could be made out in any of the arteries of the lower extremities. The feet and legs were cool and pale. There was marked diminution of tactile and thermic sensations, complete paralysis of the left lower extremity and paresis of the right lower extremity. The patient was able to move the toes of his right foot but he complained of a numbness and tingling of his lower extremities.

On August 31st temperature was 37°c., pulse, 116 and blood pressure, 130/70. There were no pulsations of any arteries in the inferior limbs. He complained of accentuated pain, principally in the left side, with numbness and tingling. The left lower extremity was completely paralyzed, but he was able to flex his right knee also performing some movements with his right foot and toes. That evening pain and numbness increased considerably in the left lower extremity, especially in the foot. At that time his temperature was 37.2°c., pulse, 112 and blood pressure, 120/80. No pulsations could be made out in either of the lower extremities.

On September 1st sensation had not returned to the lower extremities but he was able to move slightly the different parts of his right leg. Temperature was 37.3°c., pulse, 98 and blood pressure, 120/70. Oscillometric readings at pressure 100 mm. Hg were as follows: right leg, midthigh, 0.1 to 0.2 units; left leg, midthigh, 0; left arm, 4.0 to 5.0 units. The heart was not enlarged and the heart sounds were normal. On September 2nd no changes were presented. Histamine test was as follows: no reaction in either feet or legs; slight hyperemia and pain in both thighs. On September 6th, pain was limited to the left foot and the patient complained of burning and aching (Fig. 11.) On September 7th the aneurysm was about 60 per cent of its original size and no pulsations could be felt in it. On September 14th, venous pressure was 3.5 in both legs. Urine concentration test was as follows:

Time	Volume	Density
12 p.m.	100 Gm.	1.010
2 "	60 "	1.012
4 "	84 "	1.012
6 "	110 "	1.015
8 "	100 "	1.015
10 "	80 "	1.020
	534 Gm.	

On September 17th oscillometric readings at pressure 100 mm. Hg were as follows: right leg, midthigh, 0.4 to 0.5 units; left leg, midthigh, 0 to 0.1 units; left arm, 5.0 units. Pain and numbness disappeared quite completely. Movements were satisfactory in the right lower extremity and were very limited in the left.

On September 20th a neurologic examination revealed the following: All muscle groups showed greatly diminished power on both sides. Active movements were most difficult on the left side. Deep reflexes of the lower extremities, with the exception of the right Achillean, had disappeared. Cutaneous plantar reactions were abolished on the left side and were present on the right. Cremasterin reactions had disappeared. Abdominal reflexes were present. Deep sensation was normal. Thermic sensation was diminished at the inner sides of both legs and feet. Pain sensation was reduced at the outside of the feet and legs. Sphincters were perfectly continent.

On October 17th the aneurysm was only 40 per cent of its original size and no pulsations could be felt in it. In the right lower extremity faint pulsations could be felt under the inguinal band and in the popliteal region. No pulsations could be felt in the left lower extremity. Oscillometric readings (at pressure 100 mm. Hg) were as follows: right leg, midthigh, 0.5 to 1.0 units; left leg, midthigh, 0.2 to 0.4 units; left arm, 5.0 units. Pain and all uncomfortable sensations had disappeared completely. Every movement of the right lower extremity was possible but in the left leg there were only very slight movements. He could stand quite well and he was able to walk with the aid of a cane. The temperature of the right leg was normal but the left was slightly cool.

Believing at that time that the collateral blood had had sufficient time to develop, we determined to take an aortography. On October 18th the aortography was performed as follows: Spinal anesthesia with 150 mg. scurocain was administered. The contrast stain which was employed was 40 cc. of a solution of 100 per cent of natrium iodatum. The injection was made with an 18 cm. needle introduced into the aorta through the inferior left costo vertebralis angle. The machine of Reynaldo Santos was employed to obtain a pressure of 4.5 pounds. At the moment of injection the patient complained of severe pain in the abdomen and thorax lasting a few seconds. The picture obtained showed total interruption of the aorta and a very rich collateral blood supply. (Fig. 12.) On October 30th the patient was discharged from the hospital; he was able to walk without help.

On March 12, 1945, the patient came back to the hospital. He had been at work since January, 1944. His general condition was excellent. His weight had increased 45 pounds, being actually 153 pounds. (Figs. 13 and 14.) He could walk well, complaining only of a diminution of the power of the left leg and stating that the left foot became cold more easily than previously. On such occasions he felt slight pain and numbness. Examination showed that the left leg was thinner than the right. The left foot was in slight equinism causing some trouble in the gait. Neither mass nor pulsation could be felt in the region of the aneurysm. Heart size and sounds were normal. There were pulsations in all arteries of the lower extremities but none could be made out in the left dorsalis pedis.

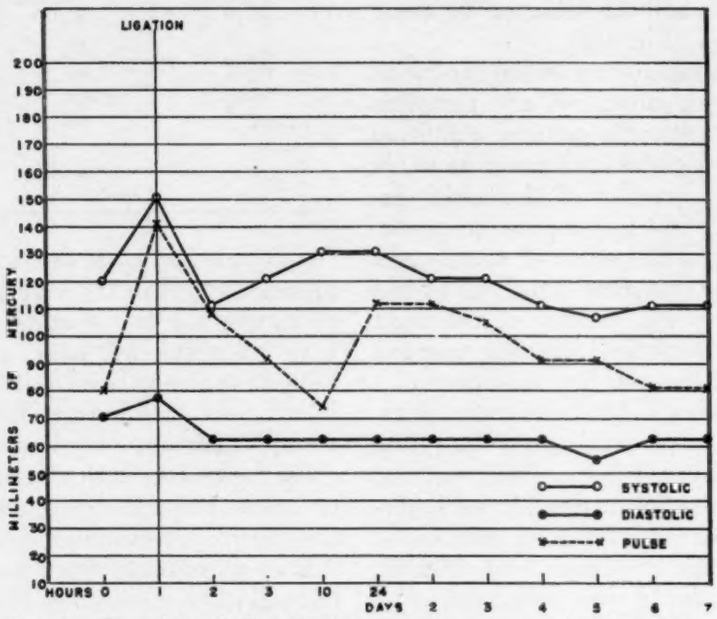

FIG. 11. Systolic and diastolic blood pressure and pulse during the first seven days after operation. The variations in blood pressure and pulse are similar to those shown by any laparatomy.

Neurologic examination showed the following: All of the deep reflexes of the lower extremities were present and normal except the left Achillean which was abolished. Abdominal, cremasterin and plantar reflexes were normal. All sphincters were active. Potentia coeundi was normal. There was slight thermic hypoesthesia in all of the left leg. The neurologic changes were certainly the result of a deficient blood supply of the nerves of the lower extremities, principally in the left side. Oscillometric readings at a pressure of 80 mm. Hg were as follows: right leg, midthigh, 2 units; left leg, midthigh, 1 unit; left arm, 5.5 units. At 100 mm. Hg the readings were as follows: right leg, midthigh, 1.5 units; left leg, midthigh, 0.5 units; left arm, 5 units.

We last saw the patient on February 4, 1947, three and one-half years after the operation. He was working and did not present any troubles or problems.

FIG 12. Aortography forty-nine days after ligation of the aorta, showing interruption at the level of the third lumbar vertebra and the appearance of collateral circulation.

COMMENT

The author is convinced that the most important factor in the cure of aortic aneurysm is the proximal occlusion of the vessel. Perhaps it may not be sufficient in some cases but no one can contest its importance because a simple complete occlusion has been performed only twice upon human beings (Brooks and Prudente) and the aneurysm was cured each time. Otherwise, subtotal occlusion itself may be sufficient as in the operation performed by Matas.

It is not my wish to discuss here the methods of chemical irritation or "wiring." I prefer the methods of external compression of aneurysmorrhaphy. As I see it the material, in order to be used in the ligation itself, must be well tolerated by the organism, must be pliable and of moderate elasticity in order to compress the artery sufficiently. The metallic bands must be abandoned because of their rigidity which causes rupture of the vessel as one can prove in all the cases in which they were used. The rubber tubes are also hard which tend to provoke ruptures and secondary aneurysms in the patients in whom they were used. (Fig. 15.) Silk, catgut or whatever other material is used in the form of thread also cause rupture of the vessel because of the pressure exerted upon a very restricted area of the wall. Therefore, the importance of tape or bands of flexible and lightly elastic material is clear. I believe that cotton tape as well as fascia lata lends itself to ligatures if it is used adequately. Monahan[37] expresses it very well in his recent work in which he says, "It would seem that proximal obliteration could very well cure aneurysms if material or a method could be obtained whereby healing of the vessel by fibrosis would occur without weakening of the vessel by the pressure of an occlusive band."

To my way of thinking there is no reason to discuss preferences for cotton tape or fascia lata. The important thing is to use them in such a way as to cause occlusion of the vessel according to the laws of nature which is to form a clot that will transform itself into fibrous tissue. At the same time it is necessary that the ligature not only does no damage to the circulation of the arterial wall (vasa vasorum) by causing ruptures but also strengthens the wall itself. I believe that the ligature applied in a spiral form after first destroying the intima of the vessel with a temporary silk ligature definitely solves the problem of total occlusion of the aorta because: (1) The crushing of the aorta with silk causes a rupture of the intima, a condition necessary for the coagulation of blood inside the vessel. As the silk thread is only temporary there is no danger of necrosis of the wall. (2) The spiral is a very elastic system with pressure distributed along a good extension of the wall of the aorta; therefore, the wall cannot be cut through so readily. (3) The expansile pulsation of the aorta works only against the upper

13 14

FIG. 13. Photograph showing patient forty days after operation. His weight was 110 pounds.

FIG. 14. Photograph showing patient eighteen months after operation. His weight was 153 pounds.

rings of the spiral in such a way that if the upper rings open the lower will close. Therefore, there is a guarantee for primary occlusion of the vessel. (Fig. 16.) (4) The lumen of the vessel at the level of the covered area through the aponeurosis acquires the form of a cone, a favorable condition for formation of a clot and its rapid organization. (Fig. 16.) (5) The double layer of the aponeurosis which covers the vessel strengthens the wall.

Admitting the fact that the total ligation of the aorta may be sufficient to cure the aneurysm of this vessel, we see in the first place what the indications or contraindications are and under what conditions it may be applied. Second, we see when it may be applied in one operation along and if it is possible to effect it gradually.

Total ligation is dangerous when the circulation of the inferior limbs is poor due to lesions of the arteries. This is more common in people past the age of fifty. In these patients the danger of gangrene is great because the collateral circulation does not find sufficient channels. The supplementary circulation is formed rapidly after ligation of the aorta because the pressure upon the capillaries and collateral vessels is very great. In older people lesions of the collateral vessels also obscure the prognosis. Control of collateral circulation may be made through preoperative aortography; however, it is not always possible to make conclusions in this respect. In the two cases in which ligation caused gangrene of the inferior limbs (Watson and Morton-Scott) we only know the data relative to the patient of Morton and Scott's. This patient was fifty-two years old and suffered from a ruptured aneurysm with retroperitoneal hematomas. This is a fact contrary to the thesis of Matas[26] who maintains that: "It would seem that, in large and leaking aneurysms with progressive subperitoneal extravasation, the collateral circulation is well established."

Treatment of patients in whom there is bad circulation in the inferior limbs is an occlusion performed in two stages making first, a simple partial ligation and second, a spiral ligation. The heart seems to support perfectly the supercharge imposed upon it. It is evident that when there is a deficiency of the myocardial muscle ligation is contraindicated. The first case

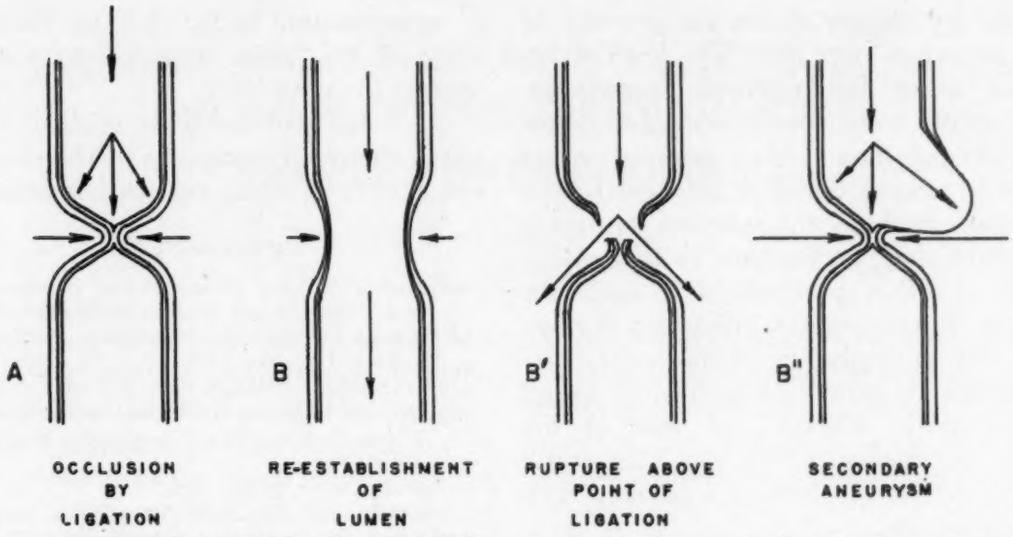

FIG. 15. Usual ligation with only a ring of different materials. Pressure in the aorta is very strong. If resistance of ligature is not sufficient, permeability of the vessel can be re-established (B). If the ligature resists, the arterial pressure acts against the wall of the artery in a line corresponding to the superior edge of the ligature resulting in its rupture (B') or a secondary aneurysm (B'').

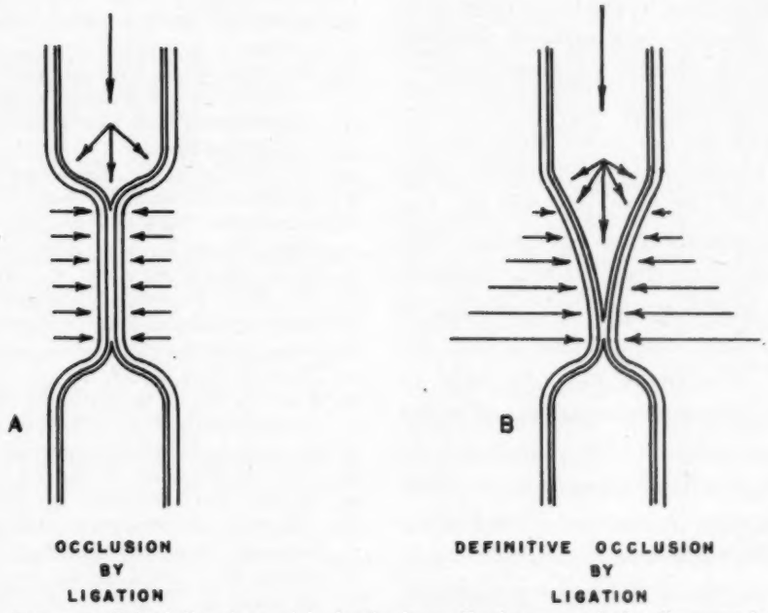

FIG. 16. Spiral ligation with fascia lata. Resistance of the ligature is distributed to a large extension of the wall of the artery (A), but being less than the aortic pressure gives up in the superior part, increasing the resistance in the inferior one. The lumen of the vessel at the level of ligature acquires a conic form, facilitating the coagulation of blood and the formation of fibrous tissue.

reported by Bigger shows the gravity of these instances very well. The level of the ligation is of fundamental importance. Good results were always obtained below the inferior mesenteric, one of them (Vaughan) being distal in relation to the aneurysm. Perhaps the solution to higher aneurysms may be ligation in two stages or use of other methods, "wiring" for example. Finally, contraindication is positive when multiple aneurysms exist, corresponding to what Annes-Dias[41] called "aneurysmatic disease" in one of his lessons on aneurysms of the abdominal aorta in which he showed a patient with nine aneurysms.

In regard to the inconveniences of a ligation of the aorta they are exclusively represented by the functional failure of the inferior limbs due to lesions of the nerves produced by the insufficiency of the blood supply. In the three cases in which total occlusion was performed (Brooks, Bigger, and Prudente), these phenomena were intense but always showed accentuated improvement followed by perfect functional restoration, allowing the patient to return to his activities. In the author's case there was no trouble with the renal function as was proved by the tests of the concentration of urine. Increase of arterial pressure which immediately follows ligation of the aorta is transitory and does not threaten the life of the patient. The same may be said in regard to the increase of frequency of pulse and respiration caused by ligation. It seems to me that these phenomena must be attributed to an irritation of the periarterial sympathetic nerves.

From observation of the case presented one may draw the following conclusions:

(1) A fascia lata ligature in spiral form effects total and definitive occlusion of the abdominal aorta.

(2) The troubles caused by ligation are of neurotrophic order due to the deficiency of the blood supply and they disappear little by little.

(3) Total and definitive occlusion of the aorta above an aneurysm of the same vessels is able to effect cure of the aneurysm.

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USE OF A CONTINUOUS NON-ABSORBABLE BURIED SUTURE THROUGHOUT IN OPERATIVE PROCEDURE

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THE lack of unified opinion as to what constitutes an ideal suture material and technic serves as a background for this presentation. The multiplicity of the routines recommended would appear to be, in itself, evidence of the absence of universal acceptance of any one as superior.

As early as 500 B.C. Susruta[7] used cotton for closure of joint and abdominal wounds. Probably the most outstanding advocate of non-absorbable sutures in more modern surgery was Halstead.[4] His successful experiences with silk are well known and his tenets have since served as basic rules for others using silk and also other non-absorbable materials. Because of their importance these tenets are reviewed. They are (1) the use of interrupted sutures; (2) the use of a fine suture material since the material need be no stronger than the tissues it re-apposes; (3) the employment of transfixion sutures to prevent slipping of ligatures and to permit the use of fine sutures; (4) the use of a greater number of fine sutures rather than a few coarse ones; (5) the advice against bridging a dead space with a suture; (6) the avoidance of a combination of absorbable and non-absorbable suture in the same case.

The first departure from Halstead's silk principles was in the use of other non-absorbable materials. Ginkovskiy[3] was one of the earliest modern surgeons to advocate other substances when, in 1936, he reported the use of cotton, first in animals and then in human beings. Other materials which have been used successfully by other surgeons include linen, chrome alloy wire, tantalum, etc.

A revival of interest in cotton was probably most stimulated by the splendid work of Mead and Ochsner.[4] They exploded the "foreign body reaction" theory and showed that cotton not only produced less tissue reaction than linen, silk or catgut but that it also retained its tensile strength within tissues longer than did these other materials. In this work with cotton the tenets of Halstead were recommended as policy, allusion being made to difficulties having arisen when they were disregarded.

The earliest noted departure from the interrupted method of the Halstead tenets in the use of non-absorbable material was by Taylor[5] in 1941. He estimated that in using his technic with cotton, his operating time was reduced 30 to 50 per cent. His method included the following: (1) the use of a single size thread, doubling it where necessary; (2) the use of a continuous suture in gastrointestinal and peritoneal closure; (3) the use of a transfixion ligature only when indispensable to hemostasis; (4) a reduction in the number of interrupted sutures by use of figure-of-eight stitches in fascia and by use of mattress figure-of-eight retention sutures in the skin and fascia. These latter also were said to eliminate necessity for interrupted suture closure of the subcutaneous fatty tissue.

Others have used part interrupted and part continuous cotton sutures. Brooks, Ashley and Thorstad[6] in 1942 followed Halsted's interrupted technic except that continuous cotton was successfully used on the peritoneum for quick closure when the spinal anesthetic was wearing off.

Reference to recent experimental and practical studies upon suture material reveal that cotton has gained a position of increasing popularity and acceptance. This would appear to be due to the fact that

it is inexpensive, pliable and produces less tissue reaction. It has a satisfactory tensile strength which is retained within the tissues. It has a high coefficient of friction and possesses stability on exposure to heat and moisture, hence is readily sterilizable. It possesses none of those disadvantages voiced against catgut, namely, difficulty of sterilization, allergic sensitivity, variable absorbability and deleterious effects of chemicals.

In considering the subject of materials and methods of suture, it occurred to the writer that doubtless there are occasions in surgical practice in which all are agreed that speed might be a contributory factor in a successful operative result. This would appear to be particularly true in instances of multiple war or industrial casualties in which time devoted to each case should be limited in order that early surgical attention may be given to as large a number of patients as possible. Using the more time-consuming interrupted technic would render such an achievement more difficult.

It was thought that even though it would depart another step from Halsted's tenets, operative time might be reduced and simplicity gained by combining the use of an increasingly more acceptable material with a technic of expediency; hence a continuous cotton suture has been used throughout in operative procedures.

Before discussing the subject further, however, I should like to refer to disadvantages that have been voiced against cotton as a suture material. First, as is the case with silk, it is said to be more difficult to handle when one has been accustomed to a coarser, less pliable material such as catgut. This awkwardness, however, was soon overcome in my experience with the practice afforded by consistent use in a few operations. It is also stated that its initial tensile strength is less than silk, linen or catgut. Again this disadvantage was overcome with practice in its use and is a factor discouraging crushing, necrosing reapositions of tissue which most surgeons have probably been guilty of executing on occasions when using material with a higher initial tensile strength. It is variously stated that cotton, as is true with all non-absorbable material, is more prone to result in sinus formation. In this series of cases, however, high incidence of sinus formation has not been noted. Again, there has been an expressed reluctance to use continuous cotton because in so doing, theoretically, a larger quantity was necessary with corresponding increase in foreign body reaction and increased likelihood of sinus formation. In a simulated wound closure in an 8-inch wound, using small bites into margins, an interrupted technic using No. 24 cotton was employed. These interrupted sutures were placed 1 cm. apart. After closure the sutures were removed and weighed. Then an incision of the same length was closed with a continuous suture from the same No. 24 spool and this suture removed and weighed. It is worthy of note that the cotton used in the continuous suture technic weighed less than that used in the interrupted technic. The weights were 19.5 mg. for the continuous and 22.5 mg. for the interrupted.

Though appreciative of variations in individual dexterity, it is here noted that the time required for closure of this 8-inch simulated wound using an interrupted technic required a little more than twice that required using the continuous suture.

Technic. Two different sizes of cotton were used. A single size, as suggested by Taylor[9] was not employed because cotton was also used for ligatures and a much smaller size (No. 70) has been used for this purpose. Again, personal experience revealed the technic to be simpler when a single larger suture was used rather than the smaller variety doubled. Though cognizant of the notable work of Localio and Hinton[5] on the varying tensile strengths of cotton from different manufacturers, no effort was made to use any particular brand, having obtained several different types in random purchasing at dime and department stores. The method of sterilization was similar to that described else-

where[6] namely, that of boiling after winding onto rubber tubing. Square knots were used throughout and no slipping or untying was noted when sutures were cut close to knots.

The technic herein outlined has been used in 187 cases. Table I indicates the size of continuous cotton employed and also the number of closures accomplished on various tissue layers. There was no mortality in this series of 187 cases. Wound complications encountered in the series are indicated in Table II.

Pertinent to these wound complications, the following comments are made. As indicated in Table II, on several occasions fluctuation developed in the wounds. These patients had no systemic reaction. In several instances the amount of fluctuation was rather conspicuous and, according to concepts based upon previous experience with catgut, would have either evacuated spontaneously or would have required drainage. These fluctuant wounds were left alone, however, and fairly rapid and eventually complete absorption took place. In three of these seven cases, there appeared to be a definite sanguineous component. In the other four serum accumulation alone was presumed to be present.

The three wound abscesses occurred in patients with appendicitis without perforation. In one instance the abscess followed use of the larger No. 12 cotton which was replaced by the smaller No. 24 after use in three cases. This one case also accounted for one of the instances of sinus formation. The other two abscesses healed without sinus formation.

Sinus formation was considered to be present in the two cases when healing was not complete four weeks postoperatively. One sinus case followed wound abscess as noted and the other was preceded by hematoma requiring evacuation. In both cases healing was prompt after removal of the suture. In neither case was it necessary to reopen the wound. A mosquito hemostat was used and the long single strand of continuous suture was located with much greater ease than previously experienced in "fishing" for an offending interrupted non-absorbable suture. Thus far, the removal of the fascial suture (size No. 24 identifying it as such) has been sufficient to permit healing in the patients developing sinus. It is presumed that healing in the fascial layer was after four weeks relatively complete. Removal of the suture has not been considered then a factor affecting wound integrity.

The following observations were made in this group of cases. A comparatively rapid closure was possible. There seemed to be a definite diminution in pain and tenderness in operative wounds as compared with those closed with any type of catgut closure. It was possible to permit patients to be out of bed much earlier in

TABLE I
SIZE OF CONTINUOUS COTTON USED AND NUMBER OF CLOSURES OF VARIOUS TISSUES ACCOMPLISHED

Tissue Approximated	Size Used			No. of Closures Accomplished
	No. 12	No. 70	No. 24	
Peritoneum	..	x	..	160
Internal oblique and transversalis, (in McBurney incision)	..	x	..	123
Deep cervical fascia (thyroidectomy)	..	x	..	5
Tunica vaginalis	..	x	..	9
Synovial membrane	..	x	..	6
Anterior sheath of rectus	..	..	x	27
Linea alba	..	..	x	16
Aponeurosis external oblique	..	..	x	123
Ligament closure (after arthrotomy)	..	..	x	7
Deep fascia	..	..	x	2
Aponeurosis external oblique (first three cases)	x	..	..	3

TABLE II
WOUND COMPLICATIONS IN 187 CASES

Complication	No. of Cases	Percentage
Wound disruption	0	
Subcutaneous Hematoma (requiring evacuation)	1	0.53
Wounds developing fluctuant (swelling not requiring drainage)	7	3.70
Wound abscess requiring drainage	3	1.59
Sinus formation	2	1.06

convalescence. This could be done because less pain attended efforts to move around and because more confidence was had in the integrity of this wound closure than in that accomplished by use of catgut. In our experience there was a decreased incidence of serum accumulation and hematoma formation as compared with a similar group of catgut closures. The reduction in incidence of hematomas was thought to be due to the fact that when cotton was used slipping of knots and premature absorption of ligatures did not occur as may when using catgut. In this series in which continuous cotton was used a decreased incidence of wound infection as compared to that in catgut closure was noted. In this connection Fisher and Burch[2] observed in reporting the treatment of 1,494 patients with appendicitis that wound infection dropped from 3.4 to 1.1 per cent after substituting cotton suture material for catgut.

Brief reference has been made in the literature to the successful use of cotton as an interrupted suture in the presence of infection. Because it had proved to be a relatively simple procedure to remove a continuous cotton suture if sinus formation did occur, it was decided to employ this closure technic in four frankly infected patients and one potentially infected in this series. In the four patients infected perforated appendix accounted for the infection present. Closure in each was accomplished without drainage. Sulfanilamide was used locally in three of these cases and an oral sulfonamide was given in all four. The potentially infected patient in whom the continuous cotton routine was used was an instance of ruptured duodenal ulcer with copious intraperitoneal spill. Healing by first intention was achieved in both the infected and potentially infected. Obviously, uncomplicated healing in five cases does not constitute conclusive evidence that such success would attend subsequent attempts. However, experience gained in these cases has suggested the justification for further observation concerning the efficacy of this method.

In summary, a departure from the described previously accepted principles of wound closure is recounted. Speed and ease of application are cited as advantages of the method. Success of the method, including reduced incidence of wound complications, has suggested its acceptability.

CONCLUSIONS

1. History of non-absorbable suture material and technic for its employment is reviewed.

2. The fact is noted that cotton as a suture material has gained a position of increasing popularity and acceptance.

3. As a routine of expediency the use of cotton as a continuous suture throughout operative procedure is suggested.

4. Possible justification for the use of this method in infected operative cases is mentioned.

5. Results are reported following use of this type of continuous cotton suture throughout in a series of 187 operative cases.

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METHOD FOR SUTURING A SHORT PULMONARY VEIN

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IN most cases pulmonary resection can be performed by the usual method of isolating the vessels and bronchus individually, with separate transfixion and ligation of each vessel on either side of the point of division. This is possible because the length of vessel isolated is sufficient to allow the placing of four sutures.

Occasionally, a pathologic condition is encountered in the lobe of the lung to be removed that prevents adequate isolation of the hilar vessel. This may be too deeply situated to allow the placing of more than a single width of clamp. This picture is seen especially when the lung fails to collapse because of pneumonitis or other rigid diseases lying immediately adjacent to the vessel. In such a difficulty the following method is suggested as a final means of controlling the short pulmonary vein adjacent to such a condition and completing the resection without incurring fatal hemorrhage:

A transfixion suture is placed peripherally as far from the pericardium as possible to control hemorrhage from the pulmonary side. Two clamps are then placed centrally to include a portion of pericardium on either side with one-half of the vessel in each clamp. The vessel is then divided distal to the clamps and the lung displaced laterally. Two interrupted fine silk sutures are then placed one at either side of the mediastinal stump of the vein, central to the clamps, to include a portion of the pericardium with the vessel wall in a transfixion suture. (Fig. 1A.) A continuous suture on a very fine needle is then begun central to the posterior clamp to overlap the interrupted suture. This is continued over the posterior clamp which is then removed and (Fig. 1B) the suture completed with the removal of the anterior clamp after the vein has been completely sutured. (Fig. 1C.)

The advantage of including the pericardium in the suture is to give strength to the thin-walled vein and to prevent the suture from pulling out. Care must be taken that the vein does not retract into the pericardium. This is largely prevented by the initial interrupted retention stitches.

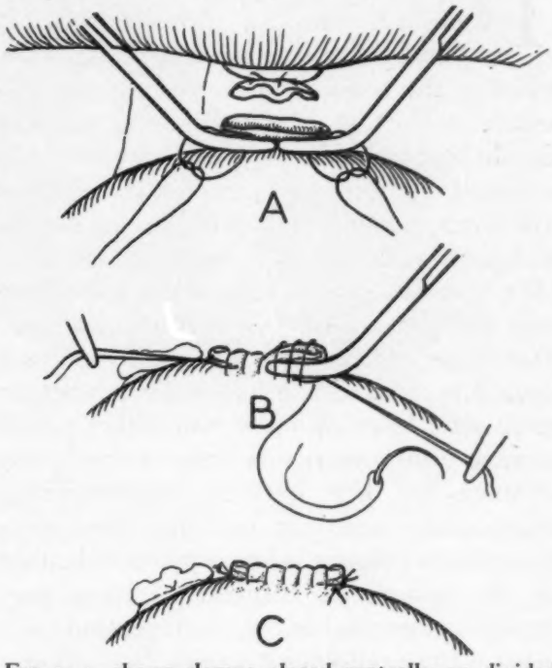

FIG 1. A, shows clamps placed centrally on divided pulmonary vein, including edge of pericardium. Retention stitches transfix pericardium and wall of vein on either side of vessel, B, shows continuous stitch overlapping the retention suture—one clamp has been and the other is about to be removed following completion of running suture; C, completed relationship of interrupted to continuous sutures is demonstrated with pericardium and vein included in both.

I have used this method with success on both pulmonary artery and vein as a means of controlling hemostasis. It eliminates the necessity of opening the pericardium to do an intrapericardial ligation, and it may be a means of assuring the operability of a lobe which otherwise might be considered inoperable. The method is advocated for those cases only in which the usual type of ligation is impossible for the reasons described.

Case Reports

AMEBIC GRANULOMA OF THE LARGE BOWEL

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THIS case illustrates the need for thorough clinical, laboratory and roentgenographic investigation of the colon in the presence of hemorrhoidal disorders with rectal bleeding. So often a simple hemorrhoidectomy has not been the answer to rectal bleeding and the patient still harbors the "bête noir" of our times, malignancy, and other more drastic lesions. This case justifiably erases the time-honored dictum "when in doubt operate." Resections of the colon still carry quite a morbidity and in the hands of competent surgeons a relatively low mortality; yet to operate unnecessarily is quite a costly experience for the patient, economically, functionally and last but not least psychologically. Again what a sad awakening for the chagrined surgeon to have performed a formidable colonic resection only to have the pathologist report "granuloma of the bowel."

The profession should utilize every diagnostic and clinical means at its command. It is only in this way we can more accurately evaluate the problem at hand. Hemorrhoids are innocuous and can wait; bowel malignancies and tumefactions cannot.

CASE REPORT

This patient was first seen by me with a chief complaint of rectal bleeding and hemorrhoids of three years' duration. The family history revealed no tuberculosis, cancer, etc. In 1928 the patient was in the service of the regular army, spent three weeks in the Panama Canal Zone and was stationed at Scoffield Barracks, Hawaii, for a period of two and one-half years. About two months after leaving Panama and while stationed at Scoffield Barracks the patient was operated upon for acute appendicitis with uneventful recovery. There was no history of bloody diarrhea at that time. During the past fourteen years the patient had been well, working as a lineman and cable splicer. His appetite and digestion were normal and there was no weight loss, no diarrhea or bloody stools.

About three years previously this patient began to have rectal bleeding associated with pain and burning sensation or defecation, constipation, protruding hemorrhoids with intermittent abdominal pains lasting three or four days which would pass away. He did not lose weight; his appetite and digestion were normal and he always continued with his work. At this time he saw his family physician who treated the patient for hemorrhoids by the injection method two to three times weekly for five or six weeks, but treatment was discontinued because the patient developed a giant urticaria. No proctoscopic, sigmoidoscopic nor stool examinations were made at this time.

Two years ago the patient had a severe bout of bloody diarrhea lasting about eight weeks. He received no medical attention since he thought he had eaten food which had not agreed with him. Since that time he had occasional abdominal pains, dull aches, associated with mild bouts of intermittent bloody diarrhea and progressively increasing constipation, with no bowel movements for as long as three days. During the latter part of his present illness the abdominal pains simultaneously became progressively worse.

Physical examination revealed a well developed and well nourished white male, forty-one years of age, not acutely nor chronically ill. He complained of rectal bleeding and painful, burning sensation on bowel movements. However, he continued to perform his regular work

until two days prior to hospital admission. His temperature was 98.6°F., pulse 80; respirations 20; blood pressure 138/74; weight 185 pounds. Eyes, ears, nose, throat and neck were normal.

No abnormalities were noted in the chest. Heart sounds were regular and of good muscular quality. An appendectomy scar was well healed. The abdomen was soft with some tenderness in both lower quadrants especially the right. No masses were palpable and there was no spasm or rigidity. The liver was within normal limits; the spleen, kidneys and gallbladder were not palpable. No hernias were present.

Rectal examination revealed external and internal hemorrhoids, with no fissures, pilonidal sinus or dermatitis. Proctoscopic and sigmoidoscopic examinations revealed the following after thorough cleansing of the bowel with enemas and catharsis: mucosa throughout was markedly hyperemic and edematous although no ulceration, masses or obstruction were noted.

The patient was admitted to my surgical service at the New York Post-Graduate Hospital for hemorrhoidectomy on March 8, 1948, for operation. However, on the eve of admission the patient still complained of abdominal pains and examination revealed moderate tenderness in both lower quadrants, especially the right with no spasm or rigidity. The morning of the operation this patient was again examined and the clinical picture of the past evening had not changed. In view of these findings together with the pathologic condition of the mucosa (rectosigmoid) and since the patient was already prepared for operation, a barium colon enema was ordered to investigate the colon more adequately. Needless to say the operation was cancelled.

To my amazement the findings were as noted in Figure 1. Since this patient had been stationed in the Panama Canal Zone and did considerable traveling to foreign ports, a stool examination was next in order. On March 12, 1948, Escherichia histolytica, cysts, Escherichia coli and nana were found. Warm, freshly passed liquid stools presented motile trophozoites of Escherichia histolytica. Warm specimens repeated on March 15th showed many trophozoites of Escherichia histolytica present but were negative for other ova or parasites.

At this time our x-ray department thought in terms of a malignancy associated with amebiasis. However, in view of the good general appearance of the patient, with a red blood count of 4,600,000 hemoglobin 15 per cent, no weight loss, a diagnosis of amebic granuloma was strongly considered. Therefore, a more conservative course and specific therapy for amebiasis was started immediately. The patient was given an adequate amount of emetine and carbarsone. (Fig. 2.) Barium colon enema presented the lesion markedly diminished after two and one-half months of emetine and carbarsone treatment. (Fig. 3.) During this latter period of therapy the patient noticed a progressively lessening of constipation; he had daily bowel movements without catharsis and no bloody diarrhea. Sigmoidoscopic and proctoscopic examinations revealed a normal mucosa.

The patient was operated upon by me at the New York Post-Graduate Hospital on May 26, 1948, for external and internal hemorrhoids with an uneventful postoperative convalescence. Examination in my office on June 25,

FIG. 1. The first barium colon enema study on March 9, 1948. This contrast clysma study shows nodular intrusinal defect about the size of a walnut on the medial aspect of the ascending colon about 2 inches above the caput apparently of neoplastic nature.

FIG. 2. Examination on April 20, 1948, with contrast enema shows the granulomatous-type lesion on medial aspect of cecum with slight diminution after six weeks of emetine and carbasone therapy.

FIG. 3. Examination on May 28, 1948, with contrast enema (as a recheck) shows a marked dimunition in the nodular granulomatous intrusinal defect on the medial aspect of the ascending colon after two and one-half months of emetine and carbasone treatment.

1948, revealed hemorrhoidal areas practically healed, his general condition excellent, appetite and digestion normal, bowel movements regular and the patient was working daily. Examination of the anorectal, sigmoidal and mucosal areas revealed everything normal so the patient was discharged.

The patient reported to my office on August 5, 1948, stating that he had been working every day with no untoward symptoms. His appetite and digestion were normal and he had daily bowel movements; his weight was 182 pounds. There was no abdominal distress nor any suggestion of bloody diarrhea. Proctoscopic and sigmoidoscopic examinations revealed normal mucosa.

COMMENT AND CONCLUSIONS

A case of amebic granuloma of the cecum is presented which was proved by laboratory studies, barium colon enema and check-up with specific therapy.

Emphasis is placed on the value of thorough investigation of the large bowel in the face of rectal bleeding with bloody diarrhea in the presence of hemorrhoids.

Amebic granuloma may be easily mistaken for malignant growths for they give symptoms, signs and proctoscopic appearances very similar to those produced by carcinoma.

The axiom "when in doubt operate" was disproved in this case. Several cases have been reported in the literature in which an extensive operative procedure was done for malignancy only to find the pathologist reporting amebic granuloma of the large bowel.

Stool examinations for ameba are most important to help substantiate the diagnosis of colonic lesions.

Ameba may occur years after the last recognized attack of dysentery.

In amebic granuloma of the rectum careful observation on proctoscopic examination, biopsy and finally the identification of Endameba histolytica established the proper diagnosis. On the other hand, in some cases the ameba may be incidental findings to carcinoma; hence the need of combining the various diagnostic procedures in order to minimize errors in diagnosis.

The recent available literature has been reviewed. Most cases have been diagnosed carcinoma. They can develop in treated and inadequately treated cases. Intensive antiamebic treatment may result in cure. The examination of stool for ameba after the tumor develops is usually negative.

Most of the patients operated upon die of peritonitis. Cancer may develop in some instances.

Amebic granuloma is localized most frequently in the cecum and the flexures of the colon as pointed out by Howard, Gunn and others but occurs also in the rectum. It is slow in developing and occurs in untreated or inadequately treated patients.

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CHRONIC THYROIDITIS

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CHRONIC thyroiditis from the time of its discovery has been the subject of much theorizing and investigation. The original report on the subject was by Reidel in 1896. Because of the characteristic "iron hardness of the gland's consistency" he called it "Eisenharte strumitis." Subsequent to this article several authors from different countries reported clinically similar cases but under varied nomenclature.

Hashimoto in 1902 reported four cases of thyroiditis. He called his cases "struma lymphomatosa." At the time he believed that his cases were clinically and particularly pathologically different from Reidel's struma. The main difference, as the name implies, was the unusual number of lymphocytes with true germinal centers invading the gland.

Following the appearance of Hashimoto's article two schools of thought developed. One group sponsored by Ewing believed that both pictures described by Reidel and Hashimoto were just steps in a progressive degenerative process. A second group believed that both types of strumitis differed both clinically and pathologically and were distinct entities.

Of late there have been many excellent papers and case reports of both types. When one reviews the literature, three facts stand out: (1) Chronic thyroiditis of either type is a degenerative process. (2) A careful history and clinical work-up discloses that there is a distinct difference in the patient presented with Reidel's struma as contrasted to Hashimoto's struma. (3) Postoperative follow-up studies have not been reported in any detail.

It is true that at first many of these differences did not present themselves until after surgery when a more careful reconsideration of the clinical picture was studied. But, of late, more case reports appear in the literature with a careful history and a detailed clinical work-up, and a preoperative diagnosis that has been confirmed at surgery and substantiated by the pathologist. In short, men who see a fair amount of thyroid work are beginning to spot these cases and diagnose the type of struma accurately.

From the standpoint of etiology of these two types of struma investigation continues. DeCourcy in two recent articles calls attention to what he calls perithyroiditis and believes that this is a true clinical entity with an acute onset. Included in the symptomatology are fevers of varying degree, often associated with chills, pain or other discomfort of the thyroid region, absence of visible inflammation and persistence of tenderness in the lobes after other symptoms have subsided.

DeCourcy emphasizes that the surgeon seldom sees Reidel's struma until the acute perithyroiditis has subsided. This is undoubtedly true. However, Case, in 1943, reported two cases of Reidel's struma. The history and clinical picture follows closely DeCourcy's idea of perithyroiditis, namely, sudden onset of fever, chills and thyroid tenderness. Both patients gave a history of a previous throat infection or a series of throat infections. Case's report was concerned more with the presence of neurotic symptoms bordering on a psychosis. He did not specify any idea of a perithyroiditis.

In 1929 McCarrison reported experimental work on rats fed on a diet of American white flour, meat residue, olive oil, salt mixture and water. He was able to produce goiters as early as seventy-five days and as late as 165 days after beginning the experiment that pathologically resembled s.

lymphomatosa. He suggested that the occurrence of the disease in humans might be on a basis of a diet deficient in vitamins, poor in carbohydrates, proteins, and fats and a scarcity of fresh fruits and vegetables.

A review of reported cases illustrates the different clinical and pathologic aspects of Reidel's struma and s. lymphomatosa. In women s. lymphomatosa is found in 90 per cent of the cases. There is usually a goiter history of three or four years with actual symptoms of twelve to sixteen months. Both lobes are involved and approximately 75 per cent of the patients develop hypothyroidism following surgery.

In Reidel's struma sex is not an outstanding characteristic and the average age is lower than that of patients with s. lymphomatosa. Symptoms are present for an average of six to seven months and, as previously pointed out, the picture of perithyroiditis may present itself. About 75 per cent of cases are of unilateral thyroid involvement and only a small percentage (about 26 per cent) develop hypothyroidism postoperatively. When one has palpated a Reidel's struma, one will always remember the extreme hardness of the gland. S. lymphomatosa is more resilient to palpation and follows more the type of colloid goiter. Patients with this type of struma present a typical squarish appearance of the neck. Both types may cause dyspnea, dysphagia and a feeling of tightness about the neck. Patients with Reidel's struma (following surgery) tend to improve rapidly, whereas patients with s. lymphomatosa have a lengthy convalescence with hypothyroid symptoms.

In s. lymphomatosa the enlargement of the gland is intracapsular and the gland is not adherent to surrounding structures except occasionally to the trachea. The consistency is firm and the gland cuts with increased resistence. The tissue is pinkish-white in color and definite trabeculae can be seen. Microscopically, although some fibrosis is present, the characteristic picture is that of a diffuse lymphoid infiltration between the acini. Numerous secondary lymphoid follicles are present and these may be very large in size. The lymphocytic infiltration varies but is most marked in the interacinar tissues. In the dense portions of lymphocytic infiltration the acini are compressed and atrophic. The epithelial cells of these atrophic acini are peculiarly large, acidophilic and have an increase in cytoplasm. They are similar to those in degenerative processes.

In cases of goiter with symptoms of hyperthyroidism, principally those who have taken much iodine, there is found lymphocytic infiltration and even follicle formation, but always in the presence of acinar hypertrophy.

Reidel's struma has a tendency to become fixed to the neighboring structures. Occasionally there is a concomitant cervical cellulitis. The gland is hard; on multiple sections the cut surfaces present nothing resembling the normal architecture of the thyroid gland. The surface presents a yellowish-gray appearance with the yellow predominating and of an almost homogeneous structure. On closer examination one finds a white net-like system of tendrils separating small lobules of firm yellowish-gray tissue.

Microscopically, the characteristic picture is one of fibrosis. This may vary from an increase in the interacinar and interlobular connective tissue to complete replacement of the parenchyma by dense connective tissue. There may be some lymphocytic infiltration. Giant cells are found usually in the region of degenerating acini. These cells are quite characteristic of Reidel's struma. Goetsch in 1940 proved that these cells originated from degenerative changes in the follicular epithelial cells which lose their cellular identity and fuse with their neighbors to form the giant cell.

The two cases reported in this paper were seen by the author in 1941. They are typical both clinically and pathologically of chronic thyroiditis known as Hashimoto's and Reidel's strumas. The patients were residents of nearby communities and postoperative follow-up studies were con-

venient to all. I became very much interested in studying the postoperative course in these patients, particularly over an extended period of time. Both patients were examined physically and basal metabolic estimations were computed every three months over a period of four years. The case histories, operative procedures and follow-up results are presented.

CASE REPORTS

CASE 1. A. T., female, forty-nine years of age of Italian extraction, was referred to us in February, 1941, with a diagnosis of possible malignancy of the thyroid. The presenting symptom was sore throat with difficulty in swallowing, increasing in severity for the past two years. The history (both recent and past) was very difficult to obtain because of language barriers. The patient was born in Sicily and had been a resident of this country for ten years. She had had an abdominal operation five years ago, the nature of which was difficult to ascertain. Her menstrual history was negative. There had been three children in the family; they were all dead and the cause was unknown. No family history was obtained.

The patient was of medium size and very apprehensive, complaining constantly of soreness and thickness in her throat with difficulty in swallowing. She had seen numerous physicians who had prescribed the usual throat procedures with no improvement. The patient wore glasses and had normal pupillary reactions. Eye grounds were negative.

There were no pathologic findings in her ears, nose or throat. In her neck there was an indurated, enlarged, tender left lobe of thyroid that was not freely movable. There was some induration on the right side but this was not as pronounced as the left. Examination of the vocal cords by the Nose and Throat Service disclosed no pathologic condition. The lungs were resonant throughout. There was some enlargement of the heart to the left. No murmurs were heard. Blood pressure was 150/80. There was an old midline abdominal scar; otherwise the abdominal examination showed negative results. There was gross tremor of the hands; otherwise, the extremities were negative. The reflexes were hyperactive.

Laboratory examination revealed the following: Urine: Straw colored and clear; albumin, negative; sugar negative; specific gravity, 1.019; microscopic, few epithelial cells per high power field. Blood: hemoglobin, 87.4 per cent; red blood cells, 4,484,000; white blood cells, 6,400; polymorphonuclears, 70 per cent; lymphocytes, 28 per cent; monocytes, 2 per cent. Blood Wassermann, negative; blood sugar, 130 mg.; blood non-protein nitrogen, 25. Basal metabolism rate, −10 per cent.

The working diagnosis at this time was a possible malignancy of the thyroid.

The patient was operated upon on February 14, 1941, using avertin as a basal and a mixture of gas-oxygen-ether. The usual low collar incision was made and the skin flap dissected free. The prethyroid muscles were incised and dissected free. The prethyroid muscles were incised and dissected with difficulty from the thyroid gland. There were numerous bands of firm adhesions between the thyroid gland and the muscles. The left lobe was enlarged to about the size of a peach. It was firm and grayish-red in color. There was moderate enlargement of the right lobe with some consistency.

A subtotal thyroidectomy was done. There was very little bleeding. The cut surfaces presented nothing resembling the normal architecture of the thyroid gland. It was of a yellowish-gray appearance with the yellow predominating and of an almost homogeneous appearance. However, a white net-like system of tendrils separating small lobules of firm yellowish-gray tissue was noted.

The pathological report showed that the specimen consisted of two segments of thyroid tissue partially covered by a thick capsule. The cut section showed homogeneous structure; the tissue was dull yellow with bands of white suggesting scarred thyroid with little or no colloid.

Sections showed thyroid tissue covered in places with a thick fibrous capsule and containing such fibrous tissue running loosely throughout the gland. In some areas the fibrous tissue appeared to be attempting to form small nodular masses. The tissue was diffusely infiltrated with a large number of giant cells and lymphocytes disrupting and causing atrophy of many of the acini. (Fig. 1.)

Diagnosis: Chronic thyroiditis (Reidel's struma).

The postoperative convalescence was uneventful and the patient was discharged February 25, 1941. At this time she weighed 114 pounds and the basal metabolism rate was −10 per cent. The patient was rechecked

in April, 1941 and her weight was 120 pounds and the basal metabolism rate was −15 per cent. She had no complaints. Her clinical course was as follows:

	Weight	B.M.R.	
July, 1941	129	−18	
November, 1941	130	−20	1 gr. of thyroid extract twice a day
February, 1942	135	−14	
June, 1942	135	−10	1 gr. daily
November, 1942	137	− 8	
February, 1943	135	− 5	No thyroid extract
June, 1944	135	+ 4	
October, 1944	136	− 2	
January, 1945	137	−+ 5	
July, 1945	135	−+ 5	

The patient had no complaint at any time during the lengthy follow-up period. She emphasized at each visit how "strong" she felt and how she could do all her housework without having "pain in her throat." As the clinical course indicates there was a transient period of hypothyroidism that was adequately controlled with medication.

Case II. H. M., a young girl eighteen years of age of Ukranian extraction, came to the Thyroid Clinic of the Troy Hospital, June 27, 1941. The chief complaint was a "swelling of the neck" of four years' duration. This swelling was slowly but progressively increasing in size. Hoarseness had been present for the past year. The tone of her voice was that of a forced harsh whisper. During this time interval she thought that her general health was unimpaired. The essential points in her past history were measles and whooping cough in her childhood. The patient stated that she had diphtheria about five years ago that was followed by a tonsillectomy about four years ago. Catamenia was established at the age of fifteen. There were no menstrual disturbances. The parents were alive and in good health. There were seven other children living and well. There was no history of familial disease.

The patient appeared to be a well nourished and well developed young girl with a pronounced bilateral, uniform swelling in the thyroid region. She was very slow acting and speaking. Her weight was 107 pounds, pulse 96 per minute, respirations 18 per minute, temperature 98.6°F. and blood pressure 115/65. The skin was warm and moist and the hair seemed to be of normal texture.

The scalp examination was negative; The pupils were equal and regular in size and reacted normally to light and accommodation. No exophthalmos was present; the eye grounds were normal. Examination of the ears was negative. There was a nasal septal deviation to the left and the mouth and nasaopharyngeal region were negative. Vocal cord examination showed no pathologic condition to be present. In the neck there was a symmetrical bilateral enlargement of the thyroid gland about four times the normal size. It was very indurated and there was tenderness on manipulation, particularly on the right side. The size of the gland gave a squarish appearance to the neck. No cervical adenopathy was present. The lungs were resonant throughout and there was no ausculatory evidence of a pathologic disorder. The heart was found to be within normal limits as to size and there were no murmurs or rhythm abnormalities. Examination of the abdomen and the genitals were negative. Laboratory examination disclosed the following: Blood Wassermann, negative; blood sugar, 110 mg. per 100; blood non-protein nitrogen, 25; creatinine, 1.1; uric acid, 12; basal metabolism rate, −15. Hematology: Hemoglobin, 82 per cent; red blood cells, 4,250,000; white blood cells, 7,850. Blood smear: Polymorpholucnears, 78 per cent; lymphocytes, 18 per cent; monocytes, 2 per cent; basophiles, 2 per cent. Weight: 118 pounds.

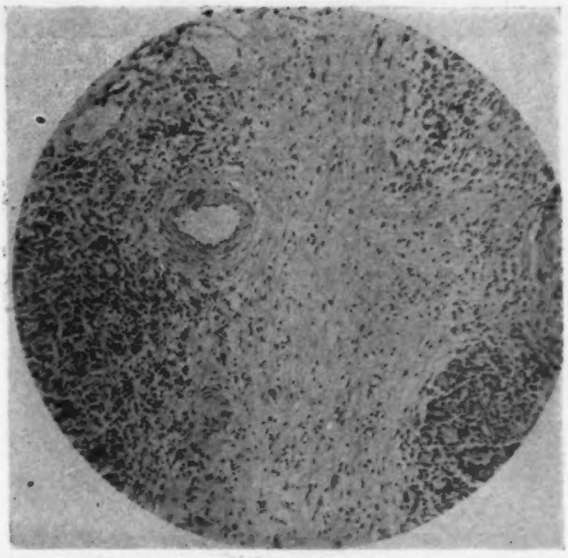

Fig. 1. Photomicrograph from Case 1 showing widespread invasion of connective tissue.

Diagnosis: Colloid goiter with pressure symptoms.

The patient was operated upon on July 10, 1941, using avertin 45 mg. per Kg. of body

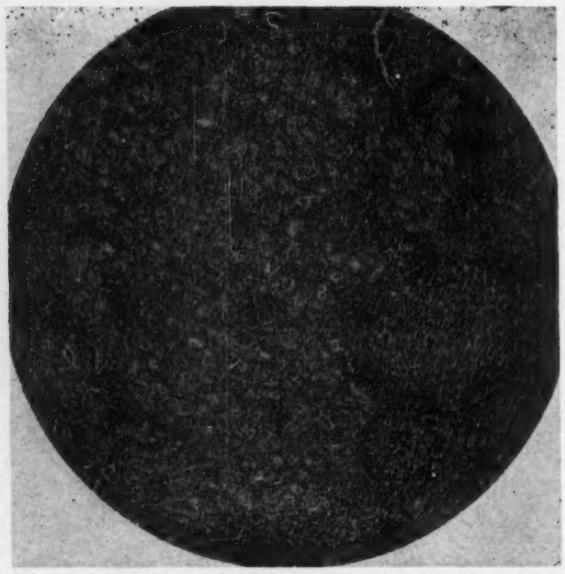

FIG. 2. Photomicrograph from Case II showing widespread invasion by lymphocytes and acinar atrophy.

weight as a basal and a mixture of nitrous oxide gas and ether. The usual low collar incision was made and the gland exposed. The contour of the gland had been preserved in spite of the evident enlargement. There were a few adhesions laterally to the strap muscles. The gland was very firm and its appearance was rather grayish. There were no nodules seen. Both superior poles were ligated and a subtotal thyroidectomy was performed.

Much to our surprise we found that the gland was very avascular, the cut surface was very irregular and the gland itself cut with quite a bit of resistance. Cross sections at the table showed a firm, uniform, opaque homogeneous structure.

There was a diffuse infiltration of the thyroid parenchyma with lymphoid tissue. This was of such a marked degree that the acinar structures were obscured and indistinct. The lymphoid tissue consisted for the most part of small mature lymphocytes although occasional hyperplastic germinal centers containing large lymphocytes were present. In the background small round to ovoid thyroid acini were observed. They were lined by a single layer of low columnar epithelium and were either devoid of colloid or contained scant amounts. (Fig. 2.)

Occasional dense collagen bands coursed through the tissue. A few foci of loose fibrous tissue containing engorged capillaries were noted. There was no evidence of glandular hyperplasia.

Diagnosis: Struma lymphomatosa.

The hospital postoperative course was uneventful and the patient was discharged from the hospital ten days later. At the time of her discharge the basal metabolism had not changed but there was a very noticeable improvement in her voice. Her postoperative course was observed and noted as follows:

	Weight	B.M.R.
July, 1941	118	−15 1 gr. thyroid extract three times a day
August, 1941	124	−20 1 gr. thyroid extract three times a day
October, 1941	128	−20 1 gr. thyroid extract three times a day
December, 1941	133	−24 1 gr. thyroid extract three times a day
February, 1942	139	−28 1 gr. thyroid three times a day
April, 1942	144	−29 1 gr. thyroid extract three times a day
June, 1942	145	−30 1 gr. thyroid extract three times a day
August, 1942	144	−18 1 gr. thryoid extract three times a day
October, 1942	136	−21 1 gr. thyroid extract three times a day
December, 1942	138	−17 1 gr. thyroid extract three times a day
February, 1943	134	−15 1 gr. thyroid extract three times a day
April, 1943	135	−16 1 gr. thyroid extract three times a day
June, 1943	134	−12 1 gr. thyroid extract three times a day
August, 1943	134	−13 1 gr. thyroid extract three times a day
October, 1943	130	−10 1 gr. thyroid extract twice a day
December, 1943	130	−10 1 gr. thyroid extract twice a day
March, 1944	130	−10 1 gr. thyroid extract twice a day
June, 1944	128	−12 1 gr. thyroid extract twice a day
September, 1944	129	−10 1 gr. thyroid extract twice a day
December, 1944	130	− 8 1 gr. thyroid extract twice a day
March, 1945	126	− 5 1 gr. thyroid extract daily
June, 1945	125	− 4 No thyroid extract
January, 1946	123	− 4 No thyroid medication

The first year following surgery was a very stormy one for the patient. She gained weight, felt "lazy," shunned her friends and wished to remain indoors. Her menstrual cycle ceased functioning for eight months but was balanced normally using A.P.L. substance with thyroid

extract. The patient had a complete personality change during this time and was very uncooperative. She was untidy in her dress and had little interest in her personal hygiene. She became a seriously disturbing influence upon other members of her family.

In the summer of 1942 her parents leased a cottage at a nearby lake and during this period the patient began to show improvement. From that time on progress was slow but steady. During the following year she worked part-time in a gift shop and in January, 1944 obtained a position as full-time saleslady. In the summer of 1945 this young lady was asymptomatic.

At this time her basal metabolism rate was −4; there were no symptoms or complaints and her weight was 125 pounds. This patient evidenced a rather severe hypothyroid reaction that was eventually controlled. I impressed upon her the importance of a check-up at least every year and sooner if she had any recurrence of her former complaints.

SUMMARY

1. Reidel's struma and Hashimoto's struma are different clinical and pathologic features of a chronic degenerative disease of the thyroid gland.

2. Conservative surgery is the procedure of choice in such cases.

3. A period of postoperative hypothyroidism that probably varies with the individual case ensues. Symptoms during this phase can be controlled medically. This period is undoubtedly a very important one and the patients should be followed carefully.

4. Following a period of four years, the two patients in this study reverted to a normal thyroid balance.

CONCLUSIONS

The one important fact that this study disclosed was the necessity of a careful clinical follow-up of the patient, using symptomatic therapy. Chronic thyroiditis is relatively rare, and one may psychologically help to control his patient with this fact, always insisting that eventually he will return to a normal condition. It is quite possible that there are patients that return to a fair thyroid balance without medication. The hormone glandular chain is well known for its wide compensating abilities and probably plays a rôle in the eventual outcome of these patients.

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HEMORRHAGIC CYST OF THE SPLEEN IN A CASE OF GAUCHER'S DISEASE*

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HEMORRHAGE resulting from insults to the spleen may present dramatic manifestations and at times pose interesting diagnostic problems. It is seen in several forms: (1) Immediate intraperitoneal hemorrhage following rupture of the splenic substance and its capsule; (2) delayed intraperitoneal hemorrhage due to the formation of a hematoma in or about the breach which subsequently ruptures; (3) no intraperitoneal hemorrhage, the hematoma remaining focal with resorption or hemorrhagic cyst formation. We have recently had the opportunity to study a case of Gaucher's disease in which a hemorrhagic cyst developed.

Hemorrhagic cysts of the spleen are rare. No previous case in Gaucher's disease has been described. The important feature in the case to be presented is not the medical curiosity but the manner in which it demonstrates the pathogenesis of splenic hemorrhage and the diagnostic problems accompanying such a lesion.

CASE REPORT

On February 8, 1942, a thirty-six year old white Jewish male was admitted to the hospital for the first time with the chief complaint of pain in the left upper quadrant, intermittent in character, moderate in severity and of one and one-half months' duration. In early January, 1942, during the course of a card game, the patient received a light blow to the abdomen. The trauma was minimal. Soon thereafter he experienced pain in the left upper quadrant and felt "dizzy and faint." The following day while at work he had a second "fainting spell." He continued to have periodic pain in the left upper quadrant and experienced many gastrointestinal symptoms such as eructation, nausea, vomiting, pain under the ribs and obstipation. He was treated by a local physician for a gastric disorder but without benefit.

Examination by another physician on January 27, 1942, revealed a cystic mass the size of an orange in the left upper quadrant extending to the umbilicus. The liver was felt 2 fingers below the costal margin. On January 31, 1942, the mass in the left upper quadrant appeared slightly larger, being felt 1 finger below the umbilicus. The blood count at this time was: hemoglobin, 94 per cent; erythrocytes, 4.89 million; leukocytes, 8,900, with polymorphonuclear leukocytes, 65 per cent; non-segmented forms, 2 per cent; lymphocytes, 25 per cent and monocytes, 8 per cent. The platelet count was 310,000/cu. mm. Sternal marrow revealed a slight shift to the left of the myeloid and erythroid elements. The total marrow count was 295,000/cu. mm. with 1,200 giant cells of the Gaucher type/cu. mm. The patient was admitted to the hospital to determine the nature of the mass.

Upon admission the patient stated that he had no episodes of weakness but had always been pale. There was no history of bone pain, bleeding tendencies or dizziness prior to the traumatic incident. The rest of the history was non-contributory.

Physical examination revealed that the patient was a well nourished, well developed, pallid, white male who did not appear acutely ill. The temperature was 99°F. and the pulse 80. Examination of the head and neck revealed barely palpable lymph nodes. The heart and lungs were normal. The blood pressure was 140/90. A large mass was felt in the left upper quadrant. This extended to the midline and 1 finger below the umbilicus. The liver was palpable 1 finger below the costal margin.

During the next eighteen days the course of the patient was studied to determine the nature of the mass. On February 9, 1942, examination of the urine was negative. The complete blood count was as follows: hemoglobin,

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100 per cent; erythrocytes, 5.4 million; leukocytes, 9,000, with polymorphonuclear leukocytes, 51 per cent; non-segmented forms, 5 per cent; lymphocytes, 34 per cent and monocytes 10 per cent. The sedimentation rate was 5 mm. the first hour and 16 mm. the second hour. On February 10, 1942, x-ray of the abdomen revealed a mass density in the region of the spleen. X-ray of the chest showed no elevation of the left dome of the diaphragm. Intravenous and retrograde pyelograms during the following week demonstrated no morphologic defect. Barium enema on February 14, 1942, revealed no intrinsic lesion of the colon but the descending colon was pushed to the right, showing evidence of extrinsic pressure. The impression was "mass of the left side causing extrinsic pressure." Repeated stool examinations were negative for blood, ova or parasites.

On February 23, 1942, a consultant stated that the cystic mass to the left of the umbilicus, apparently continuous with the spleen, "is probably not the spleen and may be retroperitoneal and of a neoplastic nature." He advised exploratory laparotomy. For this reason the patient was transferred to the surgical service of Dr. Charles Robbins. On February 26, 1942, at operation a moderately enlarged spleen was found adherent to the diaphragm. Splenectomy was performed.

Gross pathologic report was as follows: The specimen consisted of a spleen measuring 25 by 8 by 5 cm. (normal 12 by 7 by 4). The lower two-thirds of the anterior portion of the spleen was composed of an encapsulated cystic mass measuring approximately 16 by 8 by 5 cm. (Fig. 1.) This was clearly demarcated from the surrounding splenic tissue and was filled with stringy, reddish-brown, clotted material and hemorrhagic fluid. The outer surface of the cyst was roughened; the inner surface was smooth and grey-white in color. The cyst wall measured 1 mm. in thickness. At the upper pole there was another smaller cystic structure similar to that previously described, measuring 5 by 3 by 2 cm. Elsewhere the serosal surface of the spleen was smooth and glistening. The cut surface of the spleen revealed a glistening, light brown surface, studded with pinpoint and linear translucent areas.

At histologic examination paraffin sections were stained with hematoxylin and eosin, Weigert's elastic and Van Gieson and by

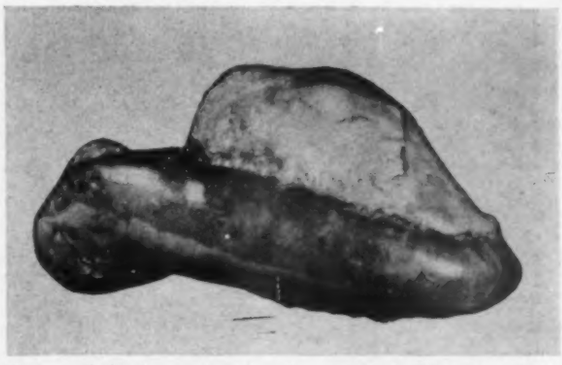

FIG. 1. Splenic cysts near the upper and lower poles.

Mallory's method for hemosiderin. That portion of the spleen not in the vicinity of the hematoma showed small, poorly demarcated Malpighian follicles. Diminution in the size of the follicles was more apparent than real and was due to the encroachment on and the partial replacement of follicles by groups of Gaucher cells. These cells were large, (30 to 50 micra) polyhedral, with relatively small nuclei and at times horseshoe in shape. The cytoplasm contained numerous fine fibrillae with irregular light areas in the meshes. (Fig. 2B.)

The large hematoma located beneath the capsule for the most part was composed of amorphous pink material, in some regions granular and in others homogeneous. (Fig. 2A.) There were several portions that may have been of recent origin since erythrocytes in these areas could still be identified although they were pale-staining. Between the clot and the splenic parenchyma there was a thick layer of young connective tissue extending into the hematoma. This formed the juxta splenic wall of the cyst. The histiocytes in this organizing tissue contained large amounts of hemosiderin and the cytoplasm of the Gaucher cells in the splenic tissue deep to the hematoma also contained small amounts of iron. Areas of well preserved erythrocytes could be seen at the periphery of the hematoma, in the center of the degenerating clot and in the substance of the young connective tissue which formed the deep wall of the cyst.

The splenic capsule formed the outer wall of the cyst. The capsule appeared to be thickened in some areas due to beginning organization of the underlying clot. Other portions showed a peritoneal reaction with fibroblasts and infiltrating lymphocytes on the external aspect of the capsule. The major portion of

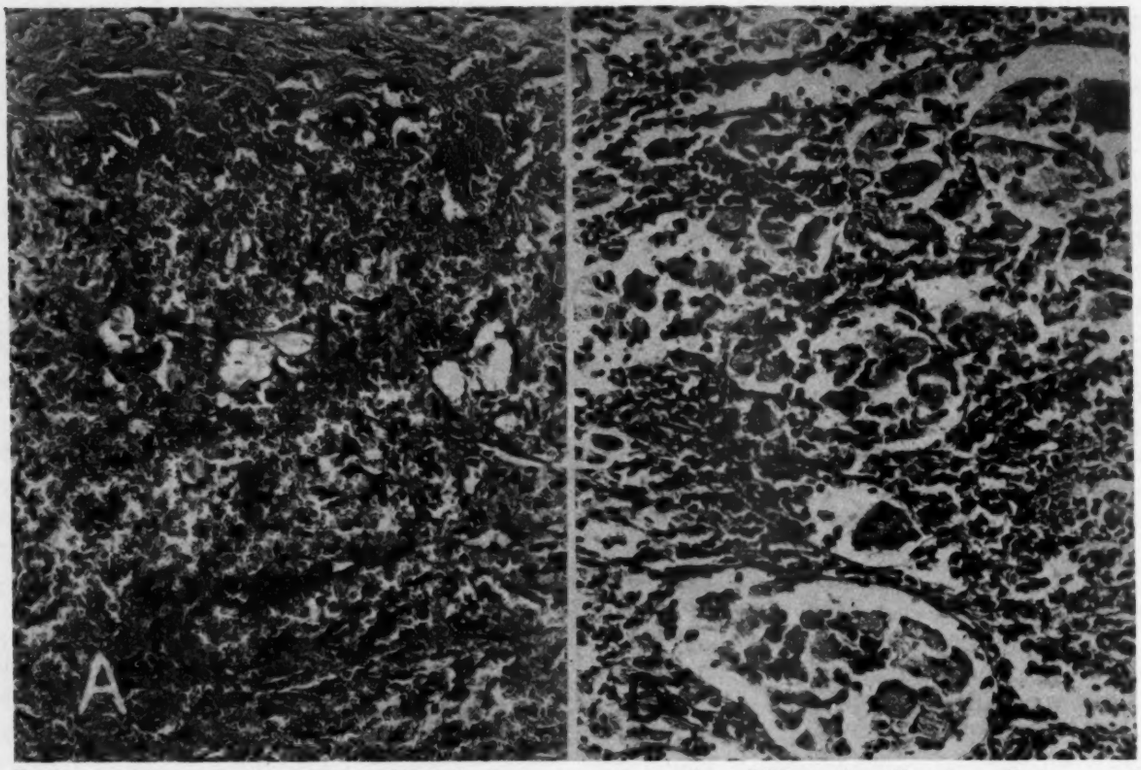

FIG. 2. A., subcapsular hemorrhage. Capsule shown at upper portion of illustration; Gaucher cells in area of organizing hemorrhage; B., shows Gaucher cells in spleen.

the splenic capsule, however, showed only beginning hyalinization of the collagen fibers.

The elastic stain demonstrated clearly that many trabeculae traversing the hematoma had been ruptured.

Diagnosis. Gaucher's disease of the spleen with formation of hemorrhagic cysts.

COMMENT

To develop logically the pathogenesis and symptomatology of hemorrhagic cyst of the spleen a brief review of splenic hemorrhage is in order.

The importance of immediate intraperitoneal hemorrhage following traumatic rupture of the splenic substance and its capsule is too well known to be discussed in this presentation. Spontaneous rupture of the diseased spleen with immediate intraperitoneal hemorrhage is also fairly well known. It has frequently been reported in malaria[21,32,28] and on occasion in leukemia,[17,29,31] infectious mononucleosis,[8,22] typhoid fever,[27] pneumonia, tuberculosis, hemophilia, polycythemia,[7] undulant fever,[36] endocarditis lenta,[12] portal vein thrombosis[1] and pregnancy.[33,35,37]

Several cases of so-called spontaneous rupture of the normal spleen have also been reported.[5,6,11,20,38,42] It may be that apparently insignificant trauma to the spleen whether it be external, mechanical[20] or internal (exaggerated physiologic response)[2] causes these spleens to rupture.

The syndrome of delayed intraperitoneal hemorrhage from a rupture of the spleen is less well known. It has frequently been referred to in the literature as "delayed splenic rupture."[16,19,26] The rupture of the spleen *per se* is immediate, whether it be a small parenchymal laceration or an extensive one involving the capsule. The delay is not in the rupture of the spleen but is, rather, the interval between the rupture of the spleen and the catastrophic intraperitoneal hemorrhage. For this reason the term "delayed intraperitoneal hemorrhage" is preferred to "delayed splenic rupture."

In the development of delayed intraperitoneal hemorrhage there are three phases: the original injury to the spleen, the insidious latent period and finally the fulminating intraperitoneal hemorrhage. The initial insult may vary from minor trauma to the left side to a severe injury. The latent period may range from hours to three months although statistics indicate that secondary massive intraperitoneal bleeding occurs most often between the third and seventh days.[13] The symptoms during this period may vary. Some patients have no complaints while others have mild abdominal discomfort or even persistent colicky pain. Localized tenderness and rigidity are uncommon. Rarely is there abdominal distention or slight temperature elevation.[25] On occasion there may be splinting of the left chest without pleural or pulmonary signs. X-ray may be negative or show cloudiness in the region of the spleen, elevation of the diaphragm or displacement of the stomach.[9] There may be an associated rib injury.[23,39]

Four original types of splenic injury have been described which result in secondary intraperitoneal hemorrhage, namely, parenchymal contusions, intrasplenic and subcapsular hematomas, initial parenchymal and capsular lacerations with perisplenic hematomas and finally pedicle tears.[41] The cause for the intervening latent period has been a subject of considerable discussion. Hageney[18] in a review of seventy cases considered the latent period to be due to intact splenic capsule in 75 per cent of the cases and the remainder due to blockage of the lacerated capsule by clots, omental adhesions or adhesions to other organs.

Onset of the fulminating secondary intraperitoneal hemorrhage is sudden and may be initiated by exaggerated physiologic response[2] causing an increase in intrasplenic pressure, or may be initiated by an increase in intra-abdominal pressure produced by exertion[30] or by straining at stool. The symptoms and signs in the third phase of the syndrome are those of severe intraperitoneal bleeding. Dullness in the left flank (Ballence's sign) or pain in the left shoulder (Kehr's sign) might give an important lead as to the source of the bleeding.

The category of "combined" intraperitoneal hemorrhage from the spleen includes those patients with initial intraperitoneal hemorrhage which becomes walled off and localized only later to result in massive intraperitoneal bleeding. Here the clinical picture is similar to that of delayed intraperitoneal hemorrhage, but from a viewpoint of pathogenesis there must be a separate classification.

Those cases of intrasplenic or subcapsular bleeding which do not result in secondary intraperitoneal hemorrhage may be absorbed, may organize or may result in the formation of hemorrhagic cysts. Fowler[14] classifies these as pseudocysts.

Many ideas have been proposed in the attempt to explain the production of hemorrhagic cysts. It is known that antecedent disease, usually with splenic enlargement, is the most important underlying factor since such spleens are more exposed to trauma and probably more easily traumatized. Enlarged spleens, furthermore, have a greater tendency toward formation of adhesions with other organs. This reduces mobility and permits a greater traumatic effect. Statistics have shown that trauma has been established as the etiologic agent in approximately 30 per cent of all cases of large hemorrhagic cysts.[10] In the case presented the spleen was enlarged, adherent to the diaphragm and subjected to trauma. The exact rôle that Gaucher's disease played in the production of the hematoma, other than splenomegaly, is difficult to evaluate. The fact that tendency to hemorrhage may occur in Gaucher's disease should be considered.[40]

Other less common causes of hemorrhagic cyst formation are inflammatory disease, vascular lesions such as thrombosis or embolism of the splenic vessels or

hemorrhage into a degenerated metastatic neoplasm.

If the cyst is small, there may be no symptoms. If it reaches a large size, as it did in this case, there may be vague digestive disturbances such as nausea, anorexia, vomiting or obstipation from the pressure of the mass. There may be pain in the form of a dragging sensation localized to the left upper quadrant. Physical examination may reveal a large mass in the left upper quadrant extending to the midline or possibly down to the umbilicus. It may be fluctuant if the contents are liquified. X-ray may reveal a high diaphragm with impaired motion, the stomach pushed to the right and the colon displaced downward and to the right. If there is calcification, this, too, is recognizable. In general the diagnosis is not too difficult if the condition is borne in mind. It must be differentiated from cysts of the pancreas, omentum and mesentery[24] as well as other retroperitoneal tumors.

The pathogenesis of hemorrhagic cysts following trauma is interesting. In 35 per cent of the cases hemorrhage occurs centrally in the parenchyma of the spleen and in 65 per cent of the cases[14] it occurs peripherally in the subcapsular region. Hemorrhage continues until there is sufficient increase in tension within the hematoma to compress the bleeding site. When organization with the subsequent formation of a fibrous wall occurs, an encapsulated hemorrhagic cystic structure results. Later, with the absorption of blood pigment, the hemorrhagic cyst may be converted into one of the serous type as occurs in 30 per cent of the cases. Calcification of the cyst wall may occur. Fowler points out that approximately 9 per cent of all such cysts become calcified.[14]

In many respects the early stages in development of a hemorrhagic cyst and of delayed intraperitoneal hemorrhage from the spleen are similar. In both, trauma is an important factor. Following this, there is a subcapsular hematoma in a large proportion of both conditions. In delayed hemorrhage before there is an opportunity for organization and fibrous encapsulation some event such as increased intrasplenic pressure due to exaggerated physiologic response[2] or increased intra-abdominal pressure from straining at stool, etc., precipitates the ominous intraperitoneal bleeding. In cyst formation the organization processes are sufficient to prevent catastrophe.

SUMMARY

1. A case of hemorrhagic cyst formation in the spleen in a patient with Gaucher's disease is presented.

2. The relationship between hemorrhagic cyst formation and ruptured spleen with delayed intraperitoneal hemorrhage is emphasized.

3. The subject of splenic hemorrhage is briefly reviewed.

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TREATMENT OF WOUNDS OF THE POPLITEAL ARTERY

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USE of Vitallium tubes in anastomosis of severed arteries, as contributed by Arthur Blakemore of Columbia University, has meant the saving of many extremities rendered ischemic after injury to the major artery of the limb. The technic requires that one have available a series of small Vitallium tubes and be practiced in their use in order to expect success in bridging the defect produced in the injured artery.

During the recent war in the Mediterranean theater a number of injuries to the popliteal artery were treated by the use of Vitallium tubes. Although it is probable that the associated injury to soft parts greatly affected the success of the treatment, no significant improvement in the results occurred in the patients in whom Vitallium tubes were used compared with those treated by other methods.

Suffice to say, a wound of the popliteal artery with extensive hemorrhage is a surgical emergency that should be attended at once. Every surgeon may at some time be faced with such a case and few will have the Blakemore tubes in assorted sizes at his disposal. In the average instance the surgeon will be forced to ligate the artery to control hemorrhage.

The appearance of ischemic gangrene of the distal portion of the lower extremity as a sequel to ligation of the popliteal artery, especially when the ligation is incident to wounding of the artery by bullet or similar agent, has become so frequent that an exceptional case warrants recitation of its management in detail. It is possible that others confronted by similar cases and employing the same measures may establish the treatment.

CASE REPORT

An American soldier, aged twenty-three, was accidentally wounded by a 7.2 mm. Beretta bullet in the medial aspect of the upper portion of the middle third of the left thigh in the region of Hunter's canal, the bullet apparently ranging downward. Within one hour the patient arrived at a station hospital where he was immediately examined. The left leg was held in semi-flexion at the knee and the foot was noted to be pale and cadaveric in appearance. The lower third of the thigh was swollen and tense with an almost board-like resistance to pressure. There was practically no external bleeding from the wound. No pulse could be felt in either the anterior or posterior tibial arteries and the veins at the ankle were not perceptable. Palpation of the leg caused extreme pain to the patient, especially when the calf muscles were touched. While the operating room was prepared, x-rays of the leg and thigh were made, using pieces of wire as markers to plot the approximate course of the bullet. It was found to have lodged between the tibia and fibula in the upper third of the leg. Under spinal novocain anesthesia with a tourniquet in place the medial aspect of the thigh was opened over Hunter's canal and the incision extended to the posterior aspect of the knee to expose the popliteal space. A huge hematoma was evacuated from the popliteal space and the torn popliteal artery visualized. The artery was found to have been lacerated longitudinally but was still held in continuity by a thin band of contused anterior portion of the vessel wall. An attempt was made to close the wound in the vessel by multiple sutures while flexing the knee; however, the artery was so badly contused that the effort was fruitless. The artery was then exposed proximally to the first large branch of the popliteal artery, and a ligature of No. 1 chromic catgut was placed just distal to this vessel. The tourniquet was released and the wound irrigated with saline to remove clots of blood while bleeding points were located and ligated. After fifteen minutes no pulsations could be detected in the distal ligated portion of the popliteal artery. The popliteal vein which had not been injured was observed to be collapsed. This vein was then doubly ligated with No. 1 chromic catgut and divided. The cut edges

1 2

FIG. 1. Lateral view of thigh with crossed wires at the point of entrance of the missile and the approximate course of the bullet through the thigh which was verified at operation.
FIG. 2. Location of bullet in upper calf region between tibia and fibula after having ricocheted from the condyle of the femur.

of the skin and muscle at the site of the wound were noted to bleed freely by this time. Sulfanilamide, 5 Gm., was dusted into the wound and closure was performed by the insertion of interrupted "O" chromic catgut sutures in the fascia. The skin closure was accomplished with interrupted fine silk sutures. A light supporting splint with a loose dressing was applied and the patient was put to bed, maintaining the leg and foot on a horizontal plane with his body. A cradle was placed over the leg to support the bed covers. The patient suffered some pain during the first three days but the foot was observed to be warm and pink in color within the first six hours following operation. Passive motion of the foot was insisted upon, beginning the third postoperative day. The incision in the thigh healed without infection. Trendelenburg exercises were begun at the end of one week at which time the patient was allowed up for short intervals on crutches. After sixty days the bullet was removed from between the tibia and fibula because of a mild persistent swelling in the calf muscles and pain experienced at that site upon weight bearing. Healing was uneventful. Physiotherapy and leg and ankle exercises of increasing force, were given at this time followed by rapid return of strength in the leg. Seventy-two days after injury the patient returned to duty. At that time no abnormality of the leg and foot could be detected except the absence of both the anterior and posterior tibial pulsations at the ankle; however, no pain was experienced by the patient even after vigorous walking or climbing stairs. Following his return to duty, periodic observations of this patient were made. After four months from the date of injury the pulse was found to be easily palpable in both the anterior and posterior tibial arteries of the wounded leg. Comparative measurement of the patient's legs at that time showed the injured leg to be 1 inch less in circumference about the thigh at the site of the injury and ½ inch less in circumference at the largest portion of the calf. Subjectively, the patient complained only of slight heaviness of the left leg and some swelling of the left ankle after long walking or standing. (Figs. 1 and 2.)

COMMENT

It is obvious that early operation is indicated in the instance of extensive laceration of the popliteal artery, not only to control loss of blood but to reduce the mounting tamponade to collateral circulation. In the case just described the tissues in the popliteal region were under

extreme tension. Sehrt and Heidreich, corroborated by Brooks, cited by Holman in Christopher's "Textbook of Surgery" have statistically and experimentally established that there is a lessened incidence of gangrene following ligation of a large artery and its accompanying vein as compared to ligation of the artery alone. Simultaneous ligation of the artery and vein aids in maintaining a proper balance between the arterial and venous systems of the extremity distal to the point of ligation. Pemberton, also cited by Holman, observed the absence of pulsation in the distal segment of a ligated artery as an evidence of inadequate collateral circulation and employed it as indication for ligation of the accompanying vein to increase resistance to the return flow of blood to the heart as an aid in establishing a more efficient collateral circulation. It was not necessary to block the lumbar sympathetics in the case herein presented because of early appearance of warmth and normal color following operation. Had there been later evidence of vasospasm, lumbar sympathetic block would have been employed during convalescence. One detail which we believe to be of important significance in the successful establishment of collateral circulation in this case was the selection of the site for ligation of the popliteal artery immediately distal to a large branch above and immediately proximal to a similar branch below the level of injury. Although thrombosis of a ligated artery progresses backward from the point of ligation to a collateral branch in most instances, a strong pulse may be observed in the proximal stump of a ligated artery for days following ligation. It appears that by ligating an artery immediately adjacent to a collateral branch, the full force of blood pressure will be translated to the collateral vessels rather than be dissipated in the blind pocket distal to the collateral branches.

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DOUBLE GALLBLADDER

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THAT a double gallbladder is a rare congenital anomaly has been proven by many investigators. Wilson[1] reviewed the literature from 1674 through 1939. Gross,[2] Stolkind[3] and more recently Guyton[4] presented excellent reviews. Guyton[4] revealed only 40 proven cases of this anomaly. To this he added his own, the forty-first. The incidence of this anomaly in man has been quoted as one case in every four to five thousand persons. Boyden[5] found, in a collective study, two cases in 9,221 cadavers from eleven anatomic laboratories.

Boyden's[5] classification of double gallbladders has been accepted by both American and European investigators. It simply divides this anomaly into two groups: vesica diversa, bilobed or cleft gallbladder which has a septum dividing the organ into two chambers emptying into a common cystic duct. The second group, vesica duplex, has two gallbladders with two cystic ducts. This second group is further divided into the "Y" type with two cystic ducts draining into a common cystic duct, and the ductular type with two cystic ducts draining separately.

Discrepancies in the literature do exist in classification of the specimens. For example, Gross[2] in 1936 reviewed six cases of bilobed gallbladder. Stolkind[3] in 1939 reported seven cases of bilobed gallbladder and added the eighth to the literature. Guyton,[5] in the most recent review, reported only five cases of bilobed gallbladder and added his own to the literature. Hilt's[6] case was presented in 1937 after Gross's[2] review. However, the only cases occurring consistently in the reviews of the previously named authors are those of Meyer,[7] Rycroft[8] and one of Phillips.[9]

It is not the purpose of this paper to classify or reclassify the specimens of this anomaly occurring in the literature. We are in agreement with Guyton[4] in his classification in which he states eleven cases were insufficiently described. We believe the case herein presented falls into the group of vesica duplex of the ductular type. Guyton[4] reviewed sixteen of this type of anomaly.[1,2,10–23]

CASE REPORT

Mrs. J. Z., A. H. A2037, a sixty-three year old white woman, was admitted on July 19, 1946, for surgical management of a progressive obstructing lesion of the sigmoid colon. The chief complaint was pain in the abdomen of a cramping character which was becoming progressively worse. She had alternate bouts of constipation and diarrhea.

The present illness had its onset three weeks prior to admission. She had lost approximately 20 pounds in the past three months which she attributed to loss of appetite. Vomiting occurred on only one occasion. The changes of bowel habit was first noted three years prior to admission.

The past history revealed three previous operations, the first twenty-seven years prior to admission at which time the right tube, ovary and appendix had been removed; at the second, fifteen years later, a thyroidectomy was accomplished; three years prior to admission at the age of sixty, she was hospitalized and treated with radium for "bleeding from the uterus."

Physical examination revealed a well developed and fairly well nourished woman in no apparent distress. Temperature on admission was 99°F. rectally, pulse 76, respiration 22, blood pressure 110/60, weight 102 pounds and height 5 feet 2½ inches. The abdomen was flaccid with some tenderness in the left lower quadrant and lower midline upon deep palpation. There were no palpable masses. Rectal examination was negative. The remainder of the examination was non-contributory. X-ray examination had been taken elsewhere and revealed an obstructing lesion of the sigmoid

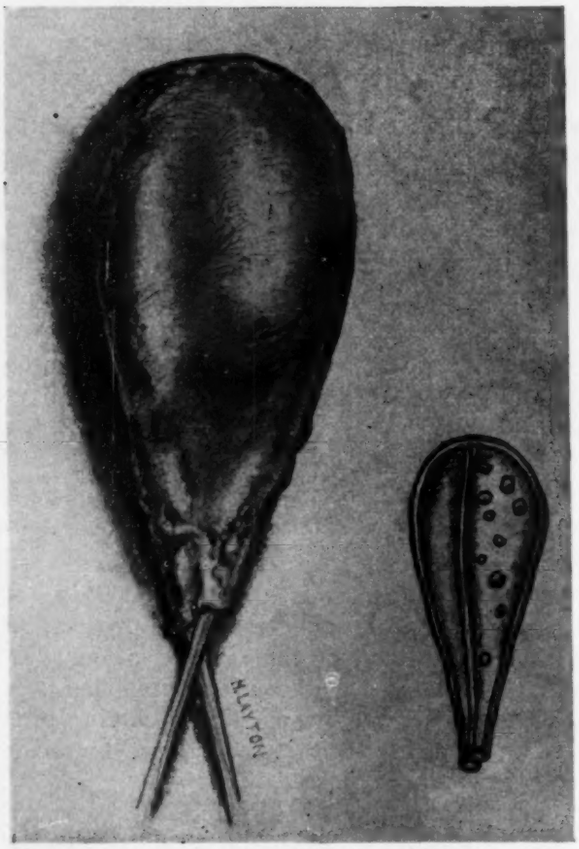

FIG. 1. Artist's drawing of double gallbladder. Note stones in the larger gallbladder which also contained darker colored bile.

colon. The red blood cell count 3,200,000, white blood cells 4,100, hemoglobin 10.8 Gm. and urine examination was negative.

On July 22, 1946, through a low transverse incision, a partial obstruction of the sigmoid was found, caused by dense adhesion between the omentum, left round ligament, ovary and tube. The adhesions were freed. Upon exploration the gallbladder was found to be markedly distended and enlarged. The wound was closed and the abdomen prepared and redraped. Through a right paracostal incision the gallbladder and bile ducts were exposed. The gallbladder and common bile duct were found to be markedly distended. To facilitate removal of the gallbladder which was found in its normal liver fossa it was aspirated and thick, dark green bile was removed. The portion of the gallbladder lying next to the liver collapsed. The needle was withdrawn and reinserted and a lighter green bile was removed. This collapsed the gallbladder. What appeared to be two cystic ducts were clamped, cut and doubly ligated. A cholecystectomy was accomplished. The common bile duct was then explored and several small stones were removed. A T tube was inserted for drainage.

The postoperative course was uneventful and without complications. The patient was up on the second postoperative day, the T tube was removed on the twelfth and the patient was discharged from the hospital on the nineteenth postoperative day.

The pathologic specimen, A. H. 15109, (Fig. 1) consists of a gallbladder 8.5 cm. long and 4 cm. across. It is made up of two separate cavities, each is lined by a mucosa. There is a complete septum between the cavities. There are two cystic ducts. These cavities are unequal in size. The larger is twice the diameter of the smaller. The large cavity is filled with a dark, thick bile and many stones with sharp corners and edges. These stones vary from 2 to 3.5 mm. in size. The smaller cavity contains a thick green bile.

Histiologic Description. A section of each of the component parts shows chronic inflammation with fibrous thickening. One of the sections contains lipoid-filled mononuclear cells. The pathologic diagnosis is chronic cholecystitis with cholelithiasis and cholesterolosis.

CONCLUSION

1. The congenital anomaly of reduplication of the gallbladder is rare.
2. A case of vesica duplex of the ductular type is presented.

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ACCORDING to Pulaski et al., streptomycin is not a panacea but does have distinct value in numerous cases, especially in instances of spreading peritonitis. They studied its effects alone or in conjunction with large doses of penicillin and occasionally also with the sulfa drugs in sixty-three patients, and they believe that streptomycin does *not* seem to have distinct value in localized peritoneal suppuration. It has proven, however, to be a valuable adjunct in most all cases of spreading peritonitis as well as in other types of surgical infection. Personally, this writer's best results in peritonitis have occurred when he combined streptomycin therapy with *large* doses of penicillin. (*Richard A. Leonardo, M.D.*)

BILATERAL CAROTID BODY TUMOR

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THE carotid body was first mentioned in the literature by Von Haller (1743) and was described by Neuber (1783). An excellent detailed microscopic description was recorded by Luschka in 1862. The first carotid body tumor was removed by Riegner in 1880 and described by Marchand in 1891. Scudder (1903) is given credit for the report of the first verified case of carotid body tumor in America. At present about 291 carotid body tumors have been described in the literature. Few surgeons have operated upon more than two patients.

Bilateral carotid body tumors are extremely rare. There are but five such cases recorded in the literature. Lund (1917) reported the first case of carotid body tumor occurring bilaterally. He removed a tumor from the right side of the neck of a patient from whom a left carotid tumor had been removed twenty-nine years previously. Rankin and Wellbrock (1931) reported a case in which bilateral tumors appeared simultaneously. In 1932 DeTarnowsky reported a case in which a tumor of the opposite side had been removed in 1904. Chase (1933) reported the occurrence of bilateral tumors in a patient whose sister had had a carotid body tumor removed. The occurrence of bilateral tumors was reported in 1939 by McNealy and Hedin; in this case the patient's brother presumably had had a carotid body tumor.

The occurrence of this tumor bilaterally is so rare that the case herein submitted is of sufficient interest to merit its report.

CASE REPORT

A white salesman, forty-eight years of age, entered this tumor service in April, 1945, complaining of progressive swelling of the glands in his neck.

The family history revealed that the patient's mother was living and well; his father was dead, the cause of death being unknown. One brother was living and well. There was no history of tuberculosis or any glandular enlargement of the neck. The past history contributed that the patient had measles and mumps in childhood. He considered his health excellent at the time of enlistment in the Army. While in the service, he contracted influenza. He had been operated upon in 1922 and a submucous resection had been done; in 1924 he had a sinus operation; in 1932 twelve teeth were extracted and in 1934 a tonsillectomy was performed. The patient denied any history of venereal disease. For the past eleven years he had not had a day of sickness or been confined to bed and had worked steadily as a salesman. The onset of symptoms began in September, 1932 after an extraction of twelve teeth. He noted a small lump beneath the angle of the jaw on the left that increased in size for a year and then seemed to remain unchanged. In March, 1943 he noted a swelling in the right side of his neck which gradually enlarged. One year prior to admission to the hospital both swellings began to increase in size so rapidly he sought medical attention.

The patient had maintained his weight of 155 pounds for the past fifteen years. His appetite had not changed and there was no history of dysphagia, nausea or vomiting. Upon questioning there was no history of dyspnea on exertion, cyanosis or palpitation. The pressure symptoms such as headache, vertigo, cough, or dysphonia were not present.

Physical examination showed that the patient was of medium height, a well nourished adult white male, well orientated and cooperative. He did not appear acutely or chronically ill; he was freely ambulant and in no pain. The patient's height was 69 inches; his weight

158 pounds. The eyes reacted to light and accommodation. The mouth revealed moderately advanced pyorrhea of the remaining teeth on the right. The nasopharynx, pharynx, buccal mucosa and tongue revealed no gross evidence of pathologic disturbances. A 6 mm. squamous cell carcinoma was seen on the lower left lip which, according to the patient, had developed within the last few weeks and obviously had no connection with bilateral masses of the neck which were of many years' duration. The patient heard a whispered voice at 15 feet with each ear and a conversational voice at 25 feet equally well.

Examination of the neck revealed bilateral masses. The mass on the right measured 8 cm. in length and 4 cm. in width. It extended from the mastoid process and from the angle of jaw and was beneath the sternocleidomastoid muscle extending downward to the mid-portion of that muscle. This mass was movable from side to side but not up and down. It was firm, smooth and non-tender. Transmitted pulse of the great vessels could not be palpated. The tumor on the left side measured 6 cm. in length, 4 cm. in width. It, too, was firm, smooth, non-tender and was more fixed to the deeper structures than its fellow. The location was approximately the same. When pressure was applied over both masses, there was only slight slowing of the heart rate. This was confirmed later by electrocardiogram tracings. No thrill or bruit was present over either mass. The blood pressure was 90/60. The heart and lungs were normal. Abdominal and neurologic examinations were negative. Examinations of the blood and urine showed nothing of interest. The electrocardiogram was normal.

Preoperatively, the patient had thirteen teeth extracted and deep x-ray therapy was used on the lesion of the lower lip. This lesion showed regression in two weeks.

The working diagnosis at the time of surgery was bilateral tumor of the neck, type undetermined. The possibility of bilateral carotid body tumor was considered.

At operation the mass on the right was approached first. Novocain, 1 per cent, was used for local infiltration and novocain, 2 per cent, was used for cervical block. An incision paralleling the sternocleidomastoid muscle was made. This muscle was retracted lateralward for some distance. The carotid sheath was entered at the level of the omohyoid muscle and the common carotid was freed to a point 2 cm. below its bifurcation. Here a tumor mass completely surrounded the common carotid. Pushing the internal jugular vein laterally, the wall of the vessel was found to be incorporated in the mass. Careful dissection from below upward was attempted but profuse bleeding was encountered. An attempt was made both laterally and medially, but these approaches were blocked by profuse bleeding. The tumor was inseparable from the arteries for two reasons: first, because of the dense adherence of its capsule to the adventitia of the vessels and, second, because of the network of the thin walled vessels that covered its surface. Returning to the carotid sheath, the vagus nerve was identified. It, too, was incorporated in the mass. A biopsy was taken and with great difficulty bleeding was controlled with suture ligatures.

At this point an evaluation of the situation led to the conclusion that the mass could be removed only by ligation of the common carotid and also the possibility that the vagus nerve would have to be sectioned. Knowing that this mass was bilateral and an unknown situation concerning blood supply existed on the opposite side, the wound was closed. Consideration was given to the possibility that the opposite side might be operable without sacrificing the blood supply. In that event ligation of the common carotid and removal of the mass on the right side could be attempted. The seriousness of this procedure, in view of the hazards which accompany ligation of the common carotid, was appreciated.

The pathologic report of the biopsy taken was carotid body tumor.

The opposite side of the neck was explored eight days later, using the same anesthesia and incision. The mass was freed from the medial border of the sternocleidomastoid muscle. It grossly resembled its fellow. The dissection was carried out from below upward and laterally. Much bleeding was encountered, but the tumor mass was freed from the common carotid and the external carotid arteries. The internal jugular vein was sacrificed. At this point the internal carotid and the vagus could not be dissected free. These structures were surrounded by the tumor and were densely adherent to it. Manipulation or traction of the mass caused immediate emesis, drop in blood pressure, slowing of the pulse and profuse sweating; therefore, only a biopsy was taken

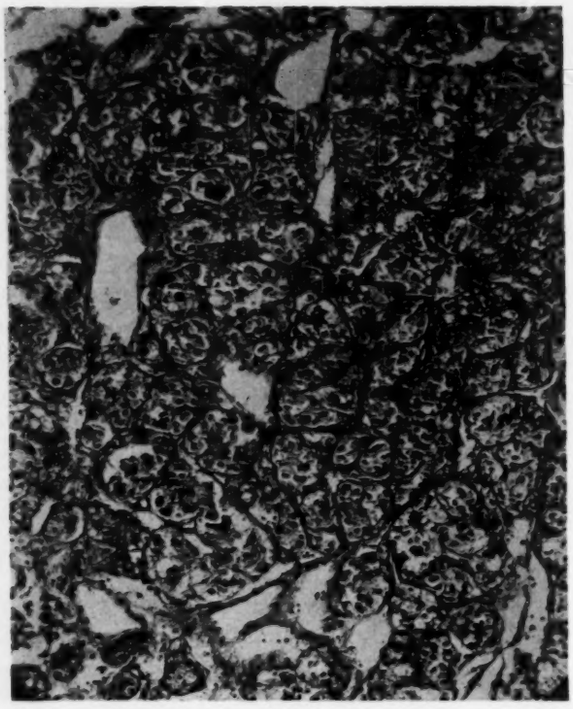

FIG. 1. Microsection of biopsy specimen removed. Note nests of polyhedral and elongate cells surrounded by vascular spaces lined with endothelial cells giving an alveolar-like appearance. 150 ×.

and the tumor was considered to be inoperable. (Figs. 1 and 2.)

Pathologically, the microscopic studies on both specimens removed were identical. Microsection disclosed a new growth made up of nests of polyhedral and elongate cells surrounded by vascular spaces lined with quite definite endothelial cells, giving the growth an alveolar-like appearance. The cells as noted were polyhedral to slightly elongate and had oval, moderately hyperchromatic, quite uniform nuclei, with practically no nucleolus. The vascular channels surrounding these polyhedral nests of cells were lined with endothelial cells. There were no mitotic figures. The cells were quite uniform and there was very little evidence of rapid growth. The diagnosis, based on microscopic study, was bilateral carotid body tumor.

Postoperatively, the patient continued to show vagal irritability and was unable to retain food for ten days. The vomiting spells gradually subsided and the wound healed without complications. Upon completion of a course of deep irradiation therapy consisting of 2,100 roentgens to each tumor mass, the patient was discharged from the hospital.

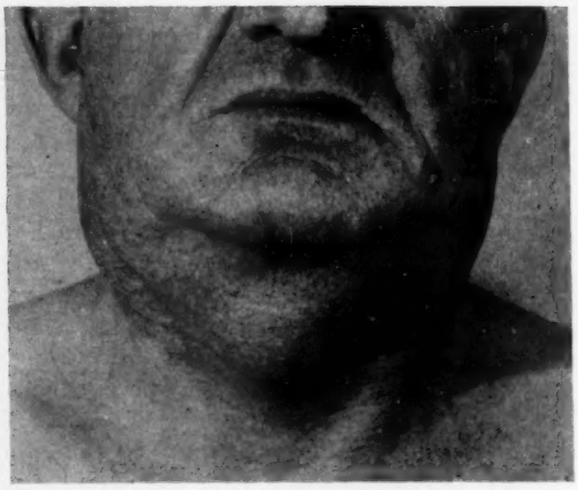

FIG. 2. Postoperative picture of patient shows the bilateral carotid body tumor which proved inoperable.

Sixteen months have elapsed since his release from the hospital. His follow-up questionnaire states that the tumors are slightly larger, cause no pressure symptoms and that he is able to work a full day.

COMMENTS

The etiology of these tumors, as of other tumors, is unknown. Both sexes are equally affected. Negroes are susceptible as well as white people. Patients vary in age from seven to seventy-three years, but 90 per cent of the cases reported have been of patients between the ages of thirty and sixty years. Of the five bilateral occurrences the familial incidence is mentioned in one.

It has been noted that the incidence of intra-oral infection preceding these tumors is remarkable. In the case presented the patient had an extraction of his teeth, tonsillitis and sinusitis. It must be mentioned again that the early carcinoma of the lower lip was of recent origin, developing a few weeks prior to admission and that from the long-standing history of the bilateral tumors they cannot be considered a part of the same pathologic process. Microscopic studies of the specimens removed confirms this contention.

It is usually considered that about 80 per cent of carotid body tumors are benign.

In this case the tumors that were present were benign histologically but malignant by position, in that circulatory embarrassment was to be expected.

In about 50 per cent of the reported cases it has been necessary to sacrifice the common carotid. This procedure carries about a 25 to 35 per cent mortality and of those that survive the operation, about 50 to 55 per cent suffer permanent brain damage. With ligation of the common carotid, the mortality rises with the age of the patient. The close proximity of this tumor mass to the vagus, hypoglossal, recurrent laryngeal, phrenic and glossopharyngeal nerves renders these structures liable to damage with various permanent defects.

SUMMARY

A case of bilateral carotid body tumor has been presented. It is interesting from a clinical viewpoint and offers a difficult surgical problem.

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FIFTEEN authentic cases of cancer of the parathyroid have been reported, only half of them being endocrinologically active. They ranged in size from 3 to 10 cm. when first seen but many become larger later. Benign tumors occur about 100 times more often than malignant tumors in the parathyroids, according to the studies of E. H. Norris. (*Richard A. Leonardo, M.D.*)

CHRONIC ABSCESSES SECONDARY TO CHOLELITHIASIS AND PERFORATION OF THE GALLBLADDER*

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FISTULOUS communications between the biliary passages and other viscera are frequently observed both at operation and at autopsy. In view of the frequency of gallstones and cholecystitis the occurrence of a fistula is an unusual complication. A discussion of the frequency and types of fistulae associated with the gallbladder has been given by Robson,[1] Judd and Burden[2] and Taylor.[3] In all probability perforation with the formation of a fistula does not take place in inflammatory disease of the gallbladder in the absence of complicating lithiasis.[2]

In reviewing the literature on fistulae associated with cholecystitis it appears that erosion of the wall of the gallbladder followed by a chronic abscess is infrequent. Usually such an abscess erodes the wall of an adjacent viscus and then produces a true fistula. The dense fibrous adhesions so often found around the gallbladder in cases of cholelithasis may in some cases develop secondary to erosion of the wall as the result of stones.

Sometimes a small, narrow sinus may connect the area of erosion in the wall of the gallbladder with a large subphrenic abscess. The etiology of such an abscess might very easily be overlooked at operation if the gallbladder is not carefully examined. The type of the contents in such an abscess cavity, of course, would be significant in determining its etiology. Those accompanying an acute empyema of the gallbladder would be that of a pyogenic process; however, if the lesion resulted from the action of bile, the contents might be brownish-black in color with few if any bacteria. Masses of bile pigment may be demonstrated in the wall. Mononuclear cells filled with fat vacuoles "foam cells" may be conspicuous in the inflammatory reaction. Hemorrhage may occur as the result of erosion of blood vessels by the bile.

Recently we have studied at autopsy two cases in which the wall of the gallbladder was eroded, apparently as the result of the presence of biliary stones. Each individual was obese, the one a male fifty-eight years of age and the other a female seventy years of age. In the former, death resulted primarily from the abscess while in the latter the clinical manifestation suggested biliary involvement; however, death resulted from bronchopneumonia. These two cases seem to be of sufficient interest from both a clinical and a pathologic standpoint to warrant publication.

CASE REPORTS

CASE 1. The patient was an obese, white male, fifty-eight years of age, who entered the hospital with the complaint of pain under the right shoulder and along the right side of the chest for twelve days' duration. These pains were sharp in character and occurred at intervals of five to ten minutes. Subsequently, they radiated to the right upper abdomen. The abdominal pains were sharp and colic-like. He was nauseated and had vomited. There was diarrhea with five to six stools daily; this was followed by constipation. The pains were present daily during the illness. An attack similar to the present one occurred eight weeks previously and subsided under forty-eight hours. He was able to work as a guard during the interval.

Upon admission the patient was obviously in pain. There was generalized abdominal

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tenderness with marked tenderness in the right upper quadrant along the costal margin. This tenderness extended downward to the lower right quadrant and across to the mid-epigastric region. A few fine râles were present at the base of both lungs. The temperature was 101.4°F.; pulses were 104 and the respiratory rate was 34 per minute. The systolic pressure was 135 mm. Hg and a diastolic pressure was 65 mm. Hg.

The white blood cell count was 14,000 two days following admission and subsequently decreased to 7,900 on the day of death. There was a moderate degree of anemia. A roentgenogram of the chest showed bilateral atelectasis in both bases. The diaphragm was elevated on both sides and an air-fluid level was thought to be present under the right arch. Fluoroscopic examination and films of the stomach and duodenum, however, did not reveal any organic disease.

The patient remained in the hospital for twelve days during which time the temperature varied between 101 and 102°F. On the last day of life the temperature reached 104.8°F. Although he appeared to improve during the first few days of hospitalization, he soon began to show signs of circulatory failure which persisted until death.

The autopsy was performed three hours after death. Only the pertinent findings are reported. The lower extremities were edematous; the abdomen was markedly distended. The gastrointestinal tract was dilated with gas and the omentum was firmly adhered to the anterior abdominal wall. A cavity was present in the area of the left colic gutter that contained approximately 800 cc. of thick, brown fluid in which there were blood clots. This cavity extended upward between the spleen and the left lobe of the liver and then turned medially. Here it lay between the diaphragm and the left lobe of the liver. The stomach was anterior and inferior to the abscess cavity. This cavity extended retroperitoneally across to the midline of the abdomen and turned downward toward the right colic gutter. The greatest amount of the contents was present in the area of the left colic gutter. The wall of the cavity was moderately thick and the inner surface was covered with a thin, brownish exudate. A small sinus 3 to 4 mm. in diameter extended directly downward from the gallbladder to join this large cavity. The wall of this sinus was similar to that of the cavity; it was bile stained. A small perforation was present in the wall of the gallbladder. The wall was thickened and was infiltrated with chronic inflammatory cells. Several stones were present in the lumen. Only a few gram-negative bacteria were present in a smear made from the contents of the large cavity.

Comment. An erosion occurred in the wall of the gallbladder secondary to the pressure produced by the stones. A small amount of bile escaped from the gallbladder and formed a short sinus which subsequently formed the retroperitoneal abscess which extended toward the left side of the abdomen. A large subphrenic abscess developed which subsequently dissected down the left colic gutter. The contents of the cavity were bile stained. It did not resemble a pyogenic abscess like those that result from a perforation in the gastrointestinal tract. Furthermore, no lesion was demonstrated in the intestinal tract. Apparently one or more blood vessels in this cavity eroded since blood clots were found within the contents.

There was little in the past history to suggest biliary disease. There was no history of jaundice. Although the roentgenographic examination of the abdomen suggested a perforation in the gastrointestinal tract, no such lesion was found at autopsy.

Case II. The patient was an obese white female, seventy years of age, who was in a semicomatose and completely disoriented state. The history was obtained from her daughter. The patient's health was "fairly good" until seven weeks previously when she suddenly developed severe pain in the epigastrium and right upper quadrant which lasted for only a few hours. This was accompanied by vomiting. Relief followed a dose of castor oil and several enemas. Similar attacks of abdominal pain occurred and three weeks previous to hospitalization the patient was weak and remained in bed. The pain persisted in the right upper quadrant and she became increasingly drowsy, uncooperative and irrational. Cathartics were given frequently during this time. The patient was thought to have had fever intermittently during the previous seven weeks.

An operation was performed on the gallbladder twenty years ago, the type of which was unknown. The daughter stated that her mother had similar attacks of pain and vomiting during the past five years. These subsided, however, following bowel movements. A chronic non-productive cough had been present for several years.

The patient appeared to be both chronically and acutely ill and was semicomatose. She was incontinent; the skin was dry. Pressure on the old scar in the upper right quadrant and deep pressure over the entire abdomen seemed to cause pain. The abdominal viscera could not be palpated; no other significant clinical findings were elicited. The neurologic examination was non-contributory. The temperature was 100°F., pulse 80 and the systolic pressure was 128 mm. Hg and the diastolic was 88 mm. Hg.

The white blood cell count was 12,900 with a normal differential. The hemoglobin was 15 Gm. The icteric index was 6 and the non-protein nitrogen was 40 mg. per cent. The total serum protein was 6.92 Gm. per cent, albumin 3.78 Gm. per cent and globulin 3.14 Gm. per cent. The albumin-globulin ratio was 1.20.

During hospitalization she remained disoriented and slept most of the time. The spinal fluid contained 49.5 mg. per cent of protein, 71.3 mg. per cent of sugar and the chlorides were 700 mg. per cent. The spinal Wassermann reaction was negative and a culture of this fluid was sterile. Three days before death a few râles were found in the base of the left lung posteriorly. Two days later moist râles were present in both lungs. The temperature at this time was 102°F., pulse 140 and respiration 60. The temperature rose to 105.8°F., her condition grew critical and she died on the ninth day of hospitalization.

The autopsy was made approximately thirty hours following death. Only the pertinent findings are included. Many dense fibrous adhesions were present around the gallbladder, some of these were continuous with the peritoneum in the area of the abdominal wall. Adjacent to the gall bladder and surrounded by fibrous adhesions were two small abscesses approximately 1 cm. in diameter. These were filled with a thick yellowish brown fluid. The wall of the gall bladder was greatly thickened except for the portion adjacent to the abscesses where it was paper thin. One black stone 2.5 cm. in diameter was present in the neck of the bladder. The surface of this stone was granular. Mononuclear cells were conspicuous in the wall of the abscess. In the cytoplasm of some of these cells were numerous, small, fat vacuoles giving an appearance to the cell of a "foam cell." Numerous small masses of bile pigment were distributed throughout the inflammatory reaction.

The liver was small and showed a moderate amount of fat within the hepatic cells. There was a minimal amount of scarring about some of the portal triads. There was some arteriosclerosis throughout the body. A large amount of bronchopneumonia was present in both lungs.

Comment. The pathologic changes in the gallbladder were adequate to account for the clinical symptoms as observed in the abdomen. A history of a "gallbladder operation" twenty years previously and attacks of pain and nausea for several years previous to death were consistant with biliary disease. There was no history of jaundice and no retention of bile pigments during her terminal period of hospitalization.

The mental symptoms presented by this patient may have resulted from the cerebral arteriosclerosis, however, it is not an infrequent clinical observation to find elderly individuals showing neurologic changes in which it is difficult to determine their etiology. Bronchopneumonia developed during her last few days of life and may be considered to be the primary cause of death.

COMMENTS

These two cases are similar in that both occurred in obese, white individuals, one a male aged fifty-eight and the other a female aged seventy. One usually considers a malignancy at this age rather than cholelithiasis; however, it should be remembered that Judd and Burden[2] found their largest percentage of cases of biliary fistulae occurred in the sixth decade of life. In a group of 153 cases one occurred in a patient between twenty and thirty years of age; seventeen were between thirty

and forty; forty-five were between forty and fifty; sixty-three were between fifty and sixty; twenty-five were between seventy and eighty. In neither of the two cases being reported is there a history of jaundice, however, in both there is a prolonged history of symptoms referable to the upper right quadrant.

A wide variety of pathologic curiosities associated with cholelithasis may be found in older publications.[1–3] Among these may be mentioned cases in which gallstones have been vomited from the stomach and coughed up from the larger bronchi. Gallstones have been found impacted in the male urethera and removed from the urinary bladder. Faber[4] records a case in which a woman voided thirteen gallstones with the urine.

Necrosis may be induced or hastened by pressure from a large biliary stone; however, local perforation may occur without a stone being present.[5] A gall bladder in which there is an impending perforation may attach itself to an adjacent viscus and establish a union between the two, permitting the stone to escape into the viscus. Unless the necrosed area is previously covered by adhesions a diffuse, frequently fatal peritonitis may result.[5] If the escaping biliary contents are small and non-infectious, a secondary walling-off may occur. A local abscess connected with a perforation in the gallbladder may rupture into parts of the peritoneum previously cut off by adhesions.[6] Robson[1] has emphasized the fact that the channel of a fistulae may be either direct, in which the two organs immediately communicate, or indirect, owing to an abscess having formed and ruptured into a contiguous hollow viscus which then communicates indirectly through the abscess cavity. In the two cases reported herein an abscess formed from a perforation in the gallbladder; however, neither communicated with a second viscus. Recently Garland and Brown[7] discussed the roentgen diagnosis of spontaneous internal biliary fistulae.

SUMMARY

Two cases are reported of chronic cholecystitis, cholelithasis and perforation of the gallbladder. In the former a small sinus extended from the gallbladder to form a large subphrenic abscess on the left which extended down into the left colic gutter. Two small abscesses occurred adjacent to the gallbladder in the latter case. Abdominal and retroperitoneal abscesses may have their origin from the gallbladder and be difficult to diagnose at operation.

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New Instruments

PORTABLE UNIT FOR PRONE POSITION SURGERY

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THE recent, rapid development of intrathoracic surgery has given rise to many improvements and innovations in the management of the patient when performing pulmonary resection and the technical procedures involved. Chief among these has been the popularization of the face down (prone) position. This was first advocated in 1944 by Overholt who has clearly outlined its advantages.[1] Since then, many surgeons have adopted this procedure.

In the lateral position, still used by many surgeons for intrathoracic operations, the diseased lung is uppermost, a condition which allows gravity drainage of secretions and débris to the good lung. In the prone position, however, especially with the diseased side slightly lowered, the chances of contralateral spillage are minimized and not infrequently by lowering the head of the table large amounts of discharge gravitate to the outside through the endotracheal tube. For this reason the face down position will prove most useful in cases of pulmonary surgery for diseases in which considerable intrabronchial suppuration occurs, e.g., lung abscess, bronchiectasis, malignancy with abscess formation, pulmonary conditions with associated bronchopleural fistula and empyema and tuberculosis with endobronchial disease and suppuration. In tuberculous cases the high incidence of spread of active disease to the normal lung following pneumonectomies and lobectomies will be decreased. Further important advantages of the face down position are a marked diminution in the amplitude of mediastinal swing and lessening of its displacement as well as a better range of expansion for the normal lung. These factors are of especial importance for patients with marked impairment of pulmonary function and will eliminate cardiovascular embarrassment in many cases.

Despite these and other advantages of the prone position, its use on a standard operating table has proved impractical. When an anesthetized patient is placed face down on the firm, flat surface of such a table, the vital capacity is appreciably diminished due to the restriction of the diaphragmatic movements. This is a serious drawback since the maintenance of respiratory function is dependent upon the diaphragm chiefly, the thoracic muscles of respiration being paralyzed under surgical anesthesia. To overcome this difficulty many makeshift arrangements have been devised, and serious complications have resulted from the use of some of these, e.g., temporary unilateral or bilateral arm paralysis, low back pain, edema of the face and chest and traumatic bruises of the skin.

Thus, the need for an apparatus which would offer surgeons all the advantages of operating in the prone position with none of the complications just mentioned has become increasingly apparent. In this regard Overholt and Comper have developed a special table for face down surgery

FIG. 1. A, the unit disassembled; B, ready for transportation.

which has proven satisfactory, and more recently the author has designed an apparatus for the same purpose which supports the upper part of the body while the pelvis and lower extremities rest upon a table. This is not an attachment to the table with incidental connections, but is a separate unit* in itself. Its chief advantages are its portability, ease of assembly and the fact that it may be used in connection with any standard operating table. (Fig. 1.)

The unit is briefly described herein and its special features outlined. It rests upon a floor base on which is mounted a hydraulic lift for height adjustment. It consists of three main parts: head rest, chest plate and arm supports. (Fig. 2.)

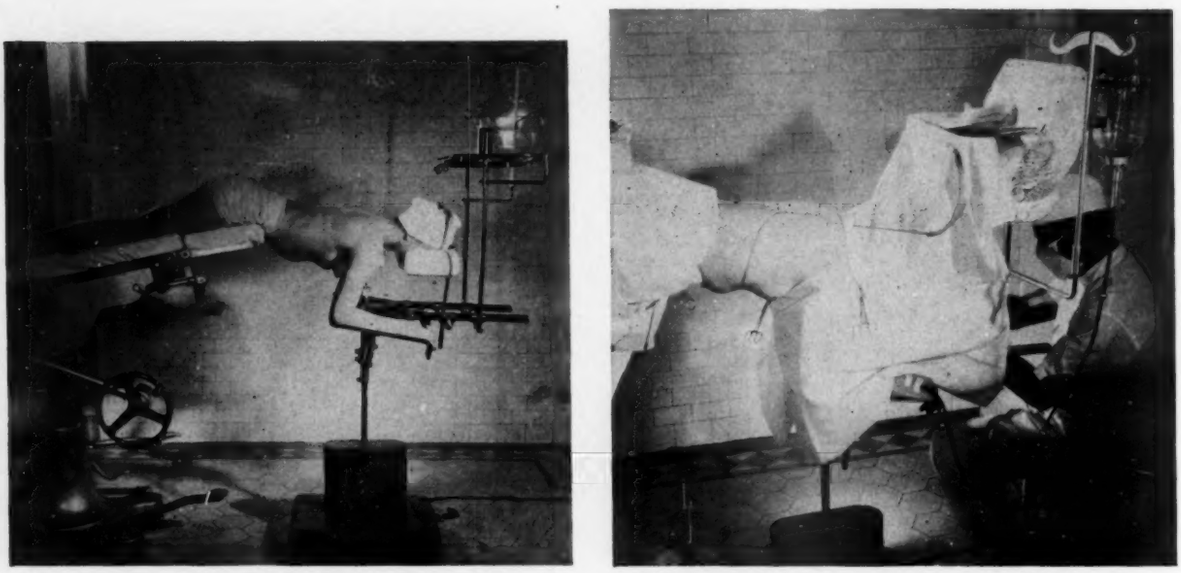
The head rest is well padded with foam rubber and is fully adjustable so that any desired degree of flexion, extension or lateral rotation of the head and neck may be obtained. It can also be quickly removed, of particular importance in the presence of an anesthetic problem.

* Manufactured by Cooperative Surgical Table Co., Brooklyn, N. Y.

FIG. 2. The assembled unit with accessories in place.

The chest plate, also padded with foam rubber, is constructed in sizes to accommodate children and adults. It supports the clavicles and the upper part of the midthorax. A ball joint attachment permits the plate to deviate in various directions. Thus, the patient may be tilted to right or left if desired in order to prevent gravity drainage. In addition the angle of the chest may be easily accommodated lessening the possibility of postoperative pain and pressure areas. This can be done by increasing the angle of the chest plate as the height of the thorax approaches that of the pelvis.

The arm supports permit a full range of motion in all directions. This provides ample room for the surgeon and allows the scapula to be elevated and abducted, creating an excellent exposure of the operative field for transthoracic surgery when the posterolateral approach is used.



A B

FIG. 3. A, the patient is shown in the operating position preparatory to lobectomy; B, same patient is shown draped; the line for incision is clearly visible.

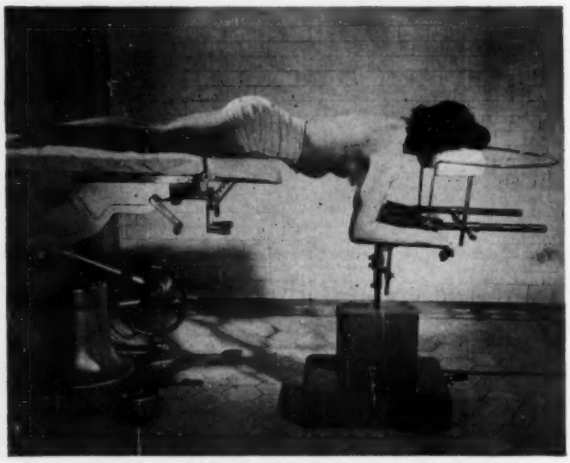


FIG. 4. Patient is shown in the operating position for upper spinal and intracranial procedures.

Removable accessories to the unit include an instrument tray, hooks for the suction tube, a fastener to prevent slipping of the endotracheal tube and holders for intravenous fluid therapy. (Fig. 3A.) The entire apparatus rotates on its base allowing the surgeon to place the patient in a position to best facilitate wound closure, (Fig. 1) of special importance when a portion of the chest wall is removed.

Support of the patient by the unit and the table (Fig. 3A) permits free and unrestricted movements of the abdomen and major portion of the thoracic cage, with only slight disturbance in vital capacity. In order to obtain the maximum efficiency of the unit with the resulting minimum ill effect to the patient the proper distribution of body weight must be achieved. This is dependent upon three variables: the angle of the chest plate, the tilt of the table and the difference in height between the table and chest plate.

The author has experienced excellent results with the patient in the position demonstrated in Fig. 3B. This shows a horizontal chest plate and a difference in height between the pelvis and thorax of approximately 6 inches. By placing the operating table in slight Trendelenburg the weight of the body on the chest and clavicles is greatly decreased.

The unit also may be used by orthopedic and traumatic surgeons for lumbar, dorsal and cervical spine procedures and by the neurosurgeon for certain intracranial operations. (Fig. 4.)

At the present writing the portable unit has been used for fifty-five thoracic operations over a period of eighteen months. These include pneumonectomy, lobectomy, exploratory thoracotomy, vagotomy, removal of a mediastinal tumor and repair of diaphragmatic hernia. At no time was

any complication evidenced as a result of its use. The author believes it to be highly satisfactory from the standpoint of the anesthetist as well as that of the surgeon.

SUMMARY

Advantages of the prone position for thoracic surgery are briefly discussed. A portable unit for this purpose is presented. Its chief advantages are that it can be easily transported and assembled and that it can be used with any standard operating table. The unit is described and its special features outlined.

Up to the present time the unit has been used for fifty-five thoracic operations and has proven to be most satisfactory.

REFERENCE

OVERHOLT, R. H. and WOODS, F. M. The prone position in thoracic surgery. *J. Internat. Coll. Surgeons*, 10: 2, 1947.

Correction: The authors of an article on "Lesions of the Large Bowel" published in our December, 1948 issue wish to call attention to an error appearing on page 651. Under the side heading, "Inflammatory Rectal Stricture," the number of patients examined from 1932 to 1945 should have read 1,134 instead of 11,134.

AN INSTRUMENT DESIGNED PRIMARILY FOR USE IN SURGICAL PROCEDURES ON THE AORTA*

RALPH A. DETERLING, JR., M.D. AND HIRAM E. ESSEX, PH. D.
New York, New York *Rochester, Minnesota*

EXPERIMENTAL studies were begun in 1938 by Gross and co-workers with surgical correction of coarctation of the aorta as their goal.[1] Independently, Crafoord and Nylin[2] in Sweden and Blalock and Park[3] in this country attacked the problem in the laboratory, with the result that successful resection of the stricture and primary anastomosis of the thoracic aorta in human beings have been accomplished. Some time ago when O. T. Clagett and one of us (R. A. D.) began experiments to develop a surgical technic for the end-to-end suturing of the thoracic aorta, we were at once confronted with the difficulty of finding an instrument which could be used to occlude and manipulate the aorta without demonstrable trauma to the wall of the vessel. Similar difficulty had been encountered by Gross and Hufnagel. Eventually by modifying the straight gastroenterostomy clamp they developed a forceps that proved satisfactory.

The requirements of such an instrument are necessarily quite strict since the aorta must be occluded evenly and with just sufficient pressure to prevent the passage of blood beyond the clamp. The wall of the aorta is damaged easily and a region of relatively minor trauma makes possible the formation of a thrombus or the subsequent development of an aneurysm. Forceps with too strong a blade may even cut through the vessel. The resultant fragmentation of the wall would obviously preclude successful repair by suture. Our first models were derived from the Carrel, Allis, Delly, Ochsner and Doyen straight clamps. Profiting by the experience of Gross and Hufnagel, we fenestrated and grooved the blades of certain of the instruments. It was believed, however, that the variation in the size and physical characteristics of the aortas encountered demanded a greater range of adaptability than that offered by the box joint and rachet type of instrument. Furthermore, a finer adjustment would have the advantage of reducing to a minimum the damage to the wall of the vessel, particularly since some torsion and angulation of the aorta by means of the instrument is necessary during the operation. In the clamps mentioned previously, the occlusive pressure was the greatest next to the lock. This uneven bite occasionally allowed some slipping of the vessel unless sufficient pressure was used and this in turn appeared to endanger the wall of the vessel. Finally, there was always the danger of the forceps springing open during the manipulation.

Consequently, we designed a screw-type, parallel jawed clamp which would give an exact, delicately controlled pressure, distributed evenly across the vessel. The length of the shaft and slight angulation allow full control of the vessel, with a large range of rotation possible. These features have the additional advantage of getting the hands of the assistant out of the operating surgeon's field. To apply the instrument the lower nut and the lock nut are screwed so as to allow the blades to come apart. (Fig. 1*a*.) When the upper blade clears the short arm, it may be rotated to one side and the lower blade then may be slipped under the vessel. With the upper blade swung back into position, the clamp is screwed close to the desired degree. (Fig. 1*b*.) The blades have longitudinal grooving and are beveled on the sides to avoid their having a cutting edge. We operated on a

* From the Division of Experimental Medicine, Mayo Foundation, Rochester, Minn.

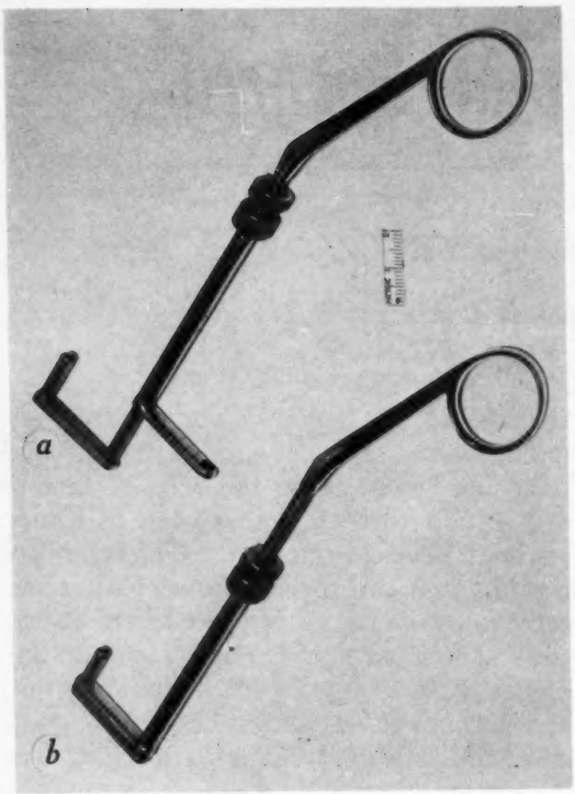


FIG 1. Illustration of instrument for surgery on the aorta.

number of dogs in survival experiments and in none was there demonstrable damage to the aorta in specimens examined between three and ten days after operation. It has not been necessary to cover the blades with cloth or rubber. A pair of these instruments with longer blades has been used successfully by O. T. Clagett and one of us (R. A. D.) on patients having coarctation of the aorta.[4]

Placing a lateral curvature in the blades may facilitate holding the proximal aortic stump in those cases in which the coarctation is immediately below the origin of the left subclavian artery. Here there is almost no cuff of aorta available for an end-to-end suture to the distal aortic stump. Fortunately, this type of coarctation appears to be less frequently encountered than that occurring from 1 to 2 cm. distal to the origin of the left subclavian artery.

This type of instrument is also of value in the experimental surgery of the esophagus where control of the viscus in three planes is necessary during the operative procedure.

We wish to acknowledge the technical assistance of Mr. Dana Rogers.

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The Early Art of Surgery

I. THE EBERS PAPYRUS

FELIX CUNHA M.D.
San Francisco, California

NOT so many years ago a German archeologist working in some ruins in Egypt was approached by a tall, swarthy, bearded stranger who winked an eye and announced that he had some treasures to sell. The archeologist took him over in a corner, where from under the folds of his robe the stranger produced various and sundry items of interest, none of which Ebers thought much of. Ebers was the name of the archeologist. It was now his turn to wink an eye at the secretive stranger and tell him that if he really had any treasures, and they really must be treasures, he was quite sure that they could do some business. The stranger left but announced that he would be back.

A couple of days later he returned, winked an eye again, and looked around with an air suggesting the need for the utmost privacy. Ebers took him off into a corner and his eyes must have popped when the stranger produced a scroll which he proceeded to unroll. Ebers was nobody's fool and he knew that he was looking at a real treasure. The only difficulty lay in who this fellow was and did he have any knowledge of the true worth of what he was showing, and above all how and where had he come by it.

The story goes that Ebers had to make some financial commitments in Leipzig before he became the possessor of this papyrus, for that is what it was.

Now while many papyrii exist in various museums throughout the world, most of them have faults and defects. Some consist of only a fragment of soiled page on which the characters are difficult to decipher. Others have been the victim of time and have been allowed to fall into a state of decay. Not so with the papyrus of Ebers. Its forty pages are clean, the characters are not dimmed and there is no sign whatever of any of the ravages of time. Ebers lost no time trying to merchandise his find. He offered it far and wide for a fabulous sum; and perhaps it was because he was so energetic and assiduous in trying to sell it, that it became known by his own name, the Ebers Papyrus, and why it is so much better known than any of the others.

The Ebers Papyrus consists essentially of many prescriptions and methods of procedure under the headings of various diseases. It is said that many of these remedies actually antedate by five hundred years their setting down in legible form; many of the formulas having been passed down by word of mouth from that time. There are sections which are of interest to the opthalmologist because many diseases of the eye and remedies for each are mentioned. For the gynecologist it describes many uterine displacements and formulas for types of douches. The obstetrician can find advice on what to do in different labors and in too free-flowing of blood during delivery.

Prescriptions for the prevention of baldness and for the growth of hair—most of them bizarre and repugnant to say the least—are given for the dermatologist.

The surgeon will find something on fractures and splints, on trephine operations for persistent headaches and epilepsy, on

The Ebers Papyrus

amputations and points of election for such, but nowhere will he find any description of suture, ligation or hemostasis. The internist will be interested to know that the diagnostician of 6,000 years ago was able to recognize that certain groups of symptoms invariably occurred together, and they are so described and classified. Physicians are designated by a special term which implies that they were to try to cure in a natural way internally and externally. No where is there a term for the one who did the amputations, cauterizations, etc.

There is much to delight the heart for the gastroenterologist and proctologist. The subject of pain in the right lower quadrant, gallstones and enlargement of the spleen in the upper left quadrant are touched upon as is also cancer of the stomach, jaundice and, last but not least, gastroptosis and enteroptosis.

Chronic constipation also plagued the physician of that day. These ancients knew of the castor bean and what it would do, and also prescribed both senna leaves and senna pods. An exceptionally capable presentation of the symptoms of both round worms and tape worms is given, and pomegranate seeds are prescribed for internal and rectal administration.

An illness of the abdomen, a "materia peccans," is described and its treatment is the thorough evacuation of the bowel, the sooner the better. Sitz baths are not at all new; the ancients used them for relief of hemorrhoidal symptoms 6,000 years ago. They knew and recognized rectal abscess, rectal fissure and fistulas, and multiple are the prescriptions for pruritus ani. An extract of juniper berries was recommended for cramps, particularly menstrual pain.

Many diarrhea prescriptions are given for the type which is with flatus and for that which is without.

"Twist in the bowel" or ileus, as we know it, is mentioned and active purgation (God forbid) is prescribed for it.

In a rough manner, this was the medicine and surgery of the oldest recording known to man. What better place to start from in order to record the additions and evolutionary processes which total up to the science as it is known to us today.

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Outside the Ivory Tower

(*continued from page 26*)

A NEW high record was set in 1946 for the proportion of births delivered in hospitals or institutions according to information released by Oscar R. Ewing, Federal Security Administrator, which summarized data prepared by the National Office of Vital Statistics of the Public Health Service. Of the 3,288,672 live births recorded for 1946, 2,708,223 or 82.4 per cent occurred in hospitals, 402,759 or 12.2 per cent were attended by physicians outside hospitals and 177,690 or 5.4 per cent were attended by midwives or other non-physicians. This is in sharp contrast with the situation that existed in 1935 (the first year that such data were compiled by the National Office of Vital Statistics). In 1935 only 36.9 per cent of the confinements occurred in hospitals, about half (50.6 per cent) of the registered births were attended outside hospitals by physicians and 12.5 per cent were attended by midwives and others.

THE American Urological Association offers an annual award of $1,000 (first prize of $500, second prize $300 and third prize $200) for essays on the result of some clinical or laboratory research in urology. Competition shall be limited to urologists who have been in such specific practice for not more than five years and to residents in urology in recognized hospitals. The first prize essay will appear on the program of the forthcoming meeting of the American Urological Association, to be held at the Biltmore Hotel in Los Angeles, May 16–19, 1949. For full particulars write the Secretary, Dr. Thomas D. Moore, 899 Madison Avenue, Memphis 3, Tennessee. Essays must be in his hands before February 15, 1949.

THOMAS P. FLEMING has been appointed librarian of the Biological Sciences Libraries and professor on the faculty of the School of Library Service at Columbia University, it was announced by Dr. Carl M. White, Dean of the School of Library Service and Director of Libraries. Mr. Fleming, who has been serving as assistant director of the Columbia University Libraries in charge of readers' services, has also been appointed to the faculty of the University's College of Physicians and Surgeons. Among the courses he will teach will be scientific bibliography.

LAST year the Metropolitan Life Insurance Company published the results of its study on the longevity and mortality of American physicians in the years 1938–1942. The records have subsequently been analyzed further in order to determine how the mortality among medical specialists compares with that for physicians in general practice, and second, how the mortality varies among physicians in the several specialties. Of the 175,146 physicians in the American Medical Directory of 1940, no less than 37,010, or 21.1 per cent of the total, were listed as full-time specialists.

The mortality among specialists at ages thirty-five to seventy-four years is only 78 per cent of that for all male physicians at these ages; for non-specialists the corresponding ratio is 110 per cent. From these figures it is evident that the mortality of specialists as a group is about one-third less than that of non-specialists. The advantage of the specialist is somewhat greater before age fifty-five than after.

Several factors undoubtedly contribute to the favorable experience among specialists. In the first place, some self-selection may be exercised by those entering a specialty, inasmuch as a certain degree of physical well-being is required to continue studies over an extended period of years. Then, too, specialists on the whole probably have a larger income than the non-specialists, and thus may be in a better position to take care of themselves by more frequent and longer vacations and by superior medical care. The specialists, concentrated in urban centers, have a further advantage in having accessibility to large hospital facilities and opportunities to consult with other specialists.

A NEW plastic used by the Navy during the war to construct radar and other special electrical equipment has been found to be "the most satisfactory substitute" for human cartilage and bone in plastic surgery, it was announced in *The Journal of Plastic and Reconstructive Surgery*.

The new plastic, named polyethylene, has been used successfully at the Kings County Hospital in the reconstruction of noses, ears, jaws and even large portions of the human skull, according to the report, presented by Dr. Leonard R. Rubin, Dr. George W. Robert-

(*continued on page 38*)

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Outside the Ivory Tower

(*continued from page 36*)

son and Dr. Raymond H. Shapiro of the hospital's Plastic Surgery Department.

In experiments on animals at the Mayo Clinic and at the Harvard Medical School, the new plastic is being used in the form of molded tubes in the reconstruction of the common bile duct and as a replacement for damaged arterial parts. In the Harvard Medical School the entire thoracic aorta, the great arterial trunk that distributes blood from the heart to almost all parts of the body, was replaced in an animal with polyethylene tubing.

A NEW Journal, *Fertility and Sterility*, to be sponsored by the American Society for the Study of Sterility, is announced by the publishers, Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers. The Journal will be devoted to original articles, reviews and abstracts on the clinical problems of sterility and impaired fertility. *Fertility and Sterility* will be published bimonthly, starting early in 1949. Each issue will be illustrated and will contain approximately one-hundred pages. Original papers on relevant topics should be addressed to Dr. Pendleton Tompkins, 450 Sutter Street, San Francisco 8, California.

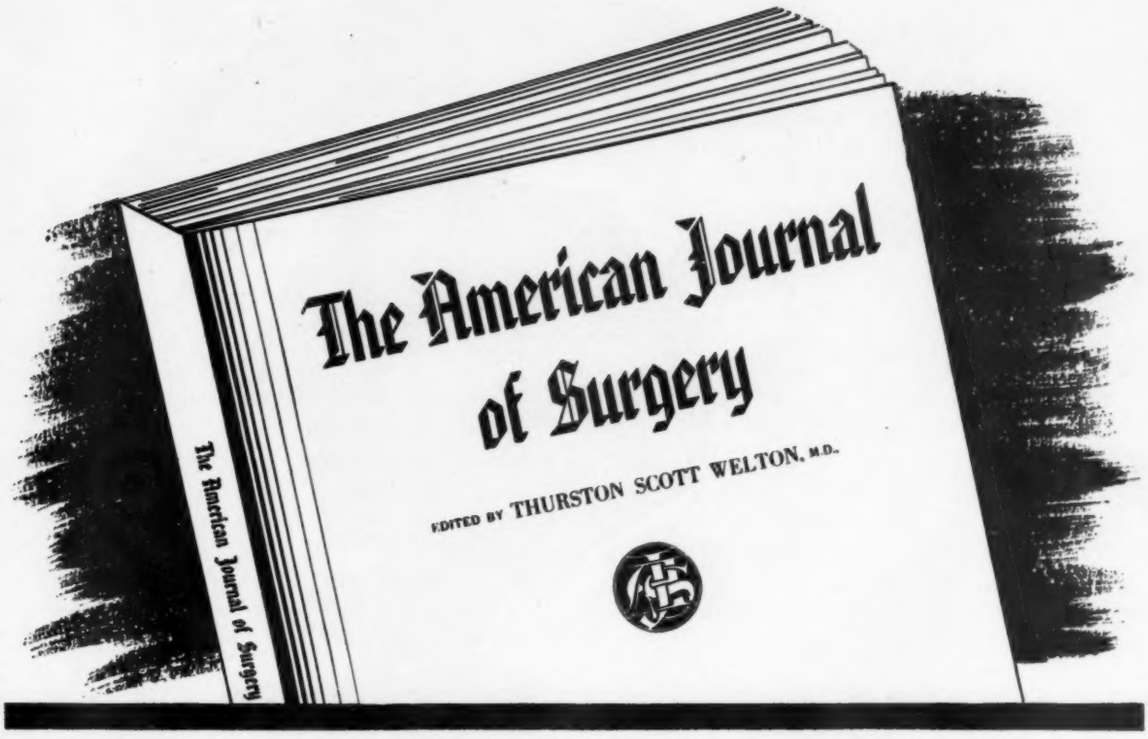
PHYSICIANS from all sections of the country submitted examples of diagnostic roentgenography in the Annual Lipiodol Awards program for 1948. The technical excellence of the many entries offer further evidence of the great progress achieved in this specialty. Awards were made to physicians in four categories of roentgenography. Entries submitted were judged for the extent of diagnostic features revealed and general technical excellence of plates in otolaryngology, bronchography, uterosalpingography and the delineation of sinus tracts. Physicians receiving awards were: otolaryngology, Dr. Henry M. Scheer, New York; bronchography, Dr. J. A. Crellin, Philadelphia, and Dr. Louis Schneider, New York; uterosalpingography, Dr. A. P. Echternacht, Crawfordsville, Indiana, and Dr. B. S. Epstein, New York; sinus tracts, Dr. Sidney E. Foster, San Francisco, and Dr. B. S. Epstein, New York.

A TOTAL of 1,445,370 deaths was registered in the United States during 1947, according to figures first released by the National Office of Vital Statistics in the Public Health Service, Federal Security Agency. This represents an increase of 49,753 deaths over the number recorded in 1946. The crude death rate for 1947 was 10.1 deaths per 1,000 estimated population. This is the second lowest rate ever recorded for the United States; the lowest was 10.0 in 1946.

DID you know that: (1) One out of every twenty Americans—more than 7 million persons—is a victim of arthritis or some other form of rheumatism? (2) Only one out of every hundred arthritic and rheumatic patients receives hospital care? (3) Less than 200 free beds in the nation's hospitals are specifically allocated to the *study and treatment* of rheumatic diseases? (4) Per capita, Congress spent about .09 for forest trails, .20 for plant and animal diseases and .40 for Department of Agriculture research last year, while *from all* sources less than one-tenth of a cent was spent for research in rheumatic diseases. (5) The country's greatest scientific organization—the National Research Council—in cooperation with the Arthritis and Rheumatism Foundation is planning a research program to find the cause and cure of rheumatic disease?

ALTHOUGH Brooklyn is 42 degrees north of the equator, it is ideal for tropical disease research because its population includes people from the world over, according to Dr. Elmer H. Louchlin, Director of the Tropical Disease Clinic at the Long Island College Hospital, one of the eighty-six non-profit member hospitals of the United Hospital Fund. Dr. Louchlin stated that drugs so new they are not yet named but are still in the number stage are being used in the clinic to combat parasitic infections which claim more deaths throughout the world than cancer, tuberculosis or plague.

MANY hospitals are finding the new Scarry soap dispenser a great improvement over old methods. By means of a photo-electric cell the soap is automatically discharged for use. While the soap may be purchased individually, the makers, E. J. Scarry & Co., Denver, Colorado, will supply it free of charge with other Scarry products.



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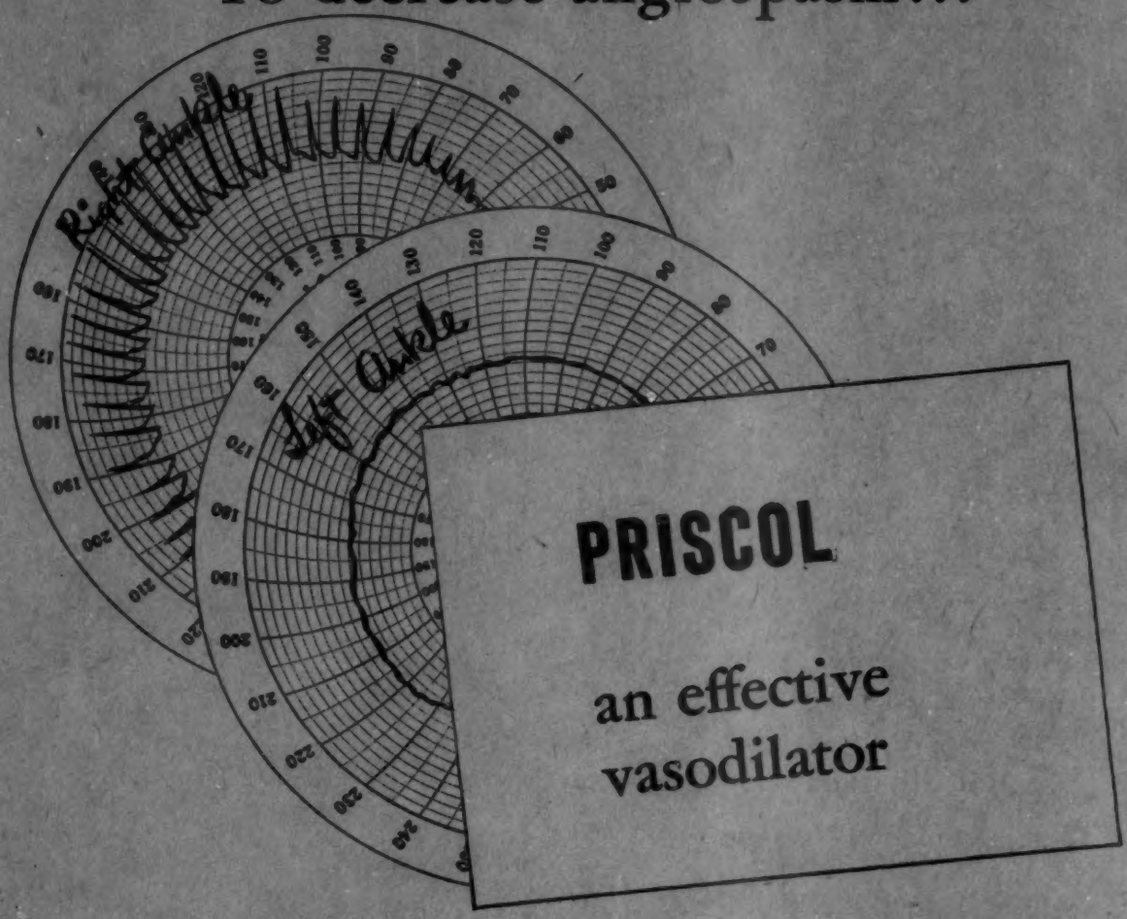
To decrease angiospasm...



Administered orally or parenterally, Priscol hydrochloride "in doses of 25 to 75 mg. is a useful adjunct to treatment of many peripheral vascular diseases, . . ."[1] including Raynaud's disease, Buerger's disease and arteriosclerotic obstructive disease.

This new sympatholytic and adrenolytic vasodilator exercises a dilating effect by blocking sympathetic vascular receptors. It also counteracts the constrictive effect of epinephrine-like substances which are formed at the vascular myoneural junction.

Patients should be closely observed until optimal dosage is established, for possible paradoxical effects or orthostatic hypotension.

1. Grimson, K. S., Marzoni, F. A., Reardon, M. J., and Hendrix, J. P.: Annals of Surgery, 127: 5, 968-990, May, 1948.

PRISCOL: Tablets of 25 mg., bottles of 100 and 1000; 10 cc. Multiple-dose Vials, each cc. containing 25 mg.

• *Complete information on request*

Ciba PHARMACEUTICAL PRODUCTS, INC., SUMMIT, NEW JERSEY

PRISCOL (brand of benzazoline)—Trade Mark Reg. U. S. Pat. Off. 2/1441M